A McGRAW-HILL PUBLICATION

OCTOBER 1961

TWO DOLLARS

# Power

the magazine of energy systems engineering

# 1961 PLANT DESIGN ISSUE

1 Industrial Plants

2 Central Stations

3 Equipment and Design Aids Roundup

OCTOBER 1961 • VOL. ~~104~~ 105 • NO. 10 • 79TH YEAR

# Power

## speaking of Power

**Planned growth** of plant facilities was an overriding thought in Fred Foy's mind as he proudly ushered a POWER editor through the new Kopper's Research Center in Monroeville, Pa. during a recent press showing. There will be but 275 staffers initially at the Center, but it can be developed to handle 1500; energy systems with supporting physical facilities are designed for a possible fivefold expansion. Chairman of the Board Fred Foy is a man convinced of the soundness of planning and investing now for tomorrow's growth. Any POWER reader would tag the carefully designed Kopper's job with a *Power-to-Grow* Index of five—the best.

During the tour, Chairman Foy was quick to point out how any building wing could be expanded by simply removing the glass-enclosed stairwell located at wing ends, adding on the needed space, then attaching stairs at end of the new addition. And since all the energy systems are deadended at each stairwell, expansion is a cinch.

Yes, industry needs more Fred Foy's . . . more top management men who can see the dollar savings in planned growth for energy systems, avoiding the trap of designing only for today. But the challenge is really yours, since it's your responsibility to convince board members and board chairmen that planning for growth pays off.

**Problems of growth** are many, with some being solved and others created by the computer. Research centers, machinery builders, insurance companies and aircraft makers are shoveling more and more of their paperwork into the willing jaws of a computer. But did you ever stop and wonder about computer failures, and how they are caused?

Dips, spikes and RF signals on the incoming power supply can often throw the superspeed abacus for a loss. Since POWER readers design the electrical systems that feed modern computers, our editors are now hard at work on a staff report for the November issue that will show what problems can be traced to power supplies, what to do about them.

Lou Rowley

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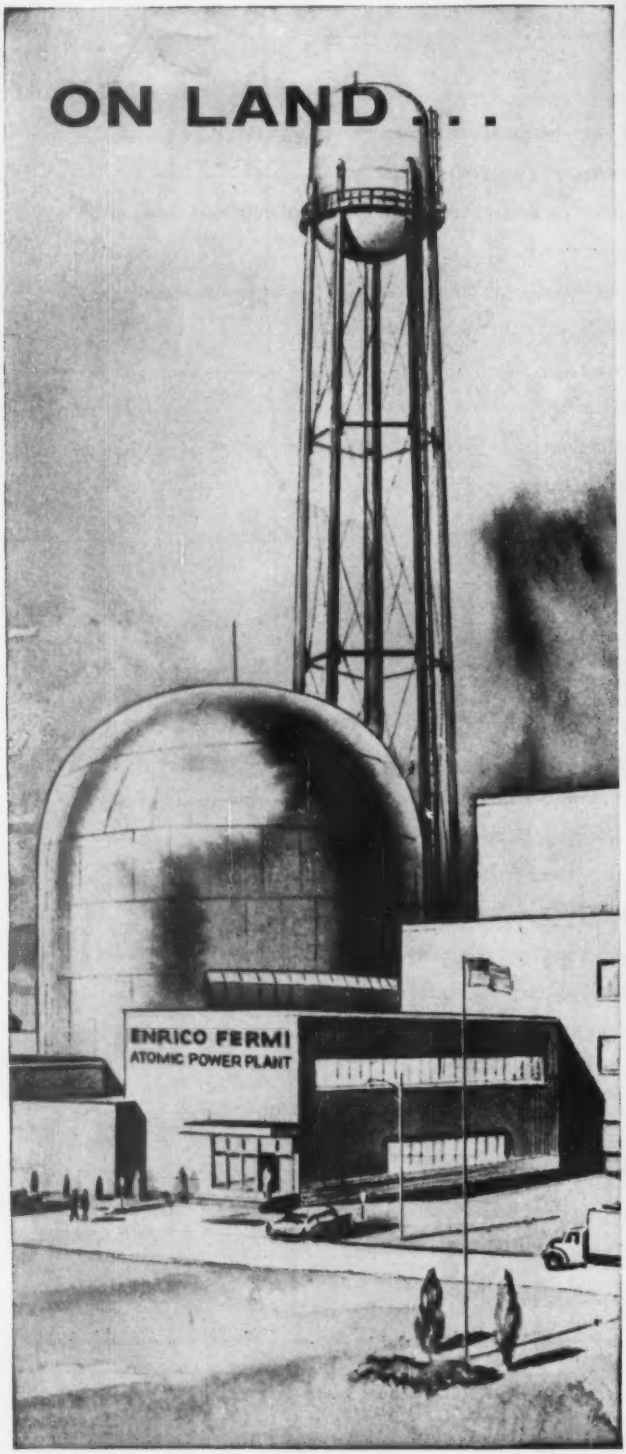
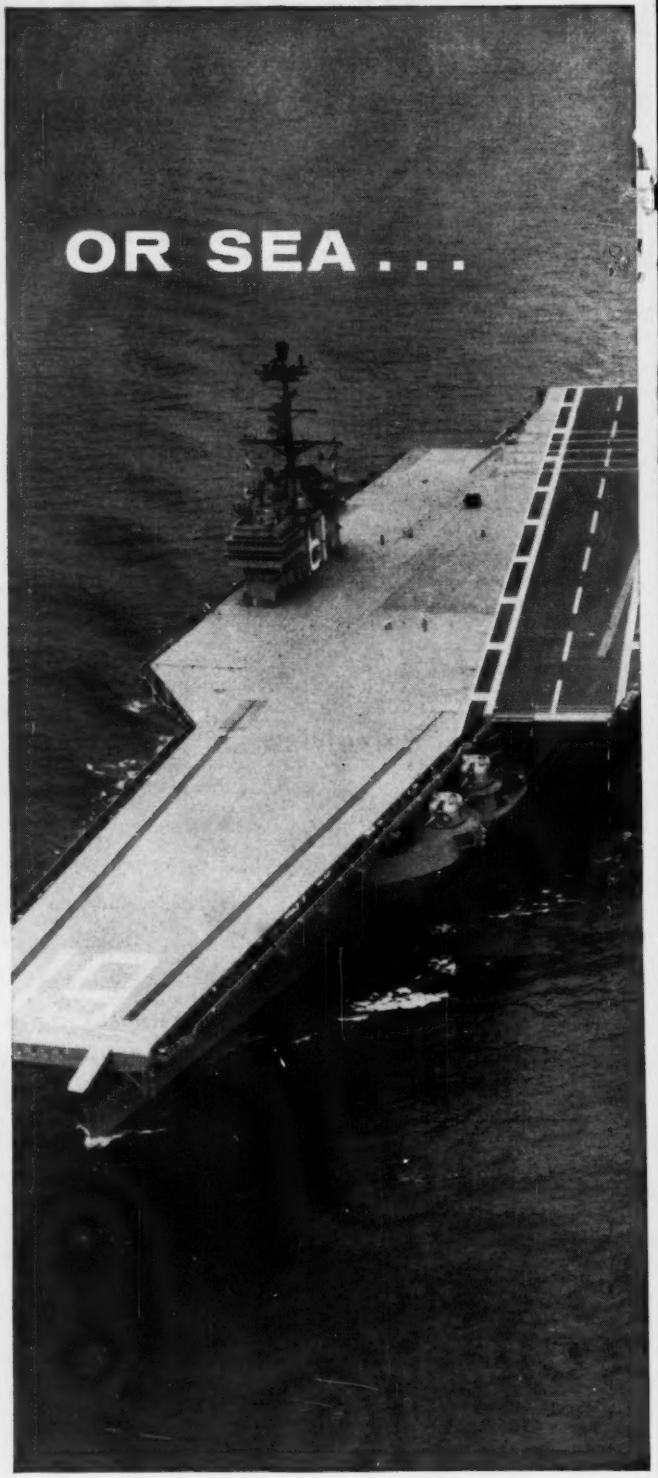



At the Enrico Fermi Atomic Power Plant, instruments and controls for both the "fast neutron breeder" reactor and the steam plant which it will "fire" are being furnished by Bailey.




Many of the new ships such as this super-carrier, USS Ranger, operate their boilers by Bailey Meter Control. Cargo ships, tankers, and passenger liners as well as Naval ships improve the economy and safety of their steam plants thru use of Bailey controls.

At the Thomas H. Allen Electric Generating Station of the City of Memphis, Tenn., Bailey operating indicators and controls for combustion, feed water, and steam temperature are centralized on the mechanical bench-board directly ahead, while the operating records which reflect trends are mounted on the vertical boards. A Bailey METROTYPE Information System, center left in the photo, scans, monitors, and logs functions usually assigned to strip-chart recorders.

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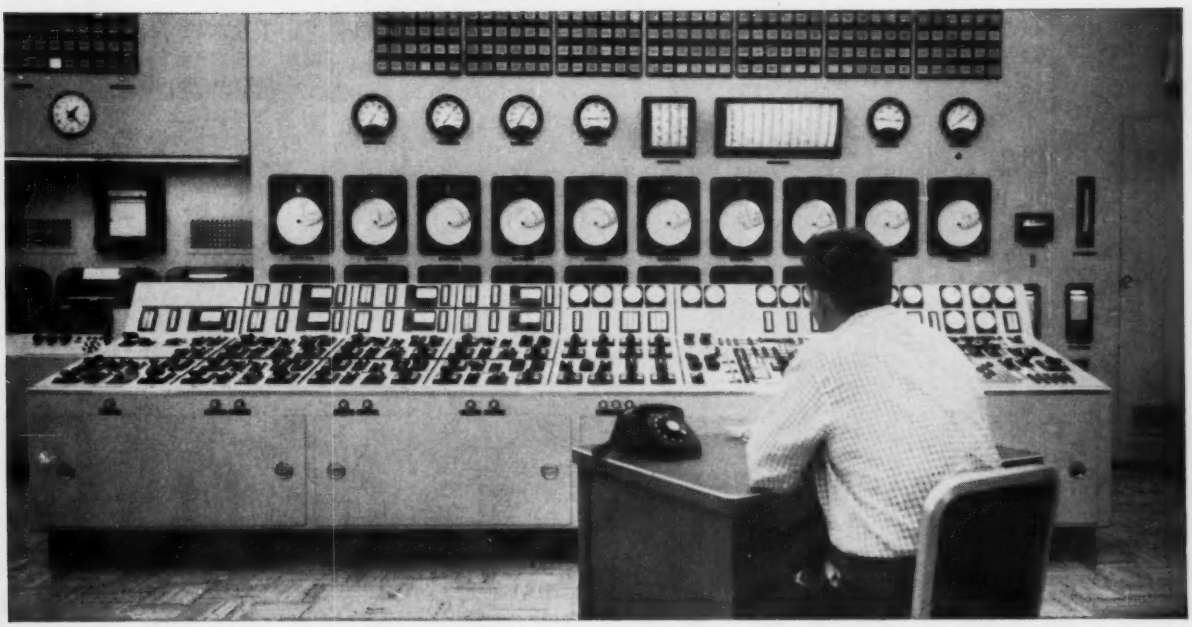

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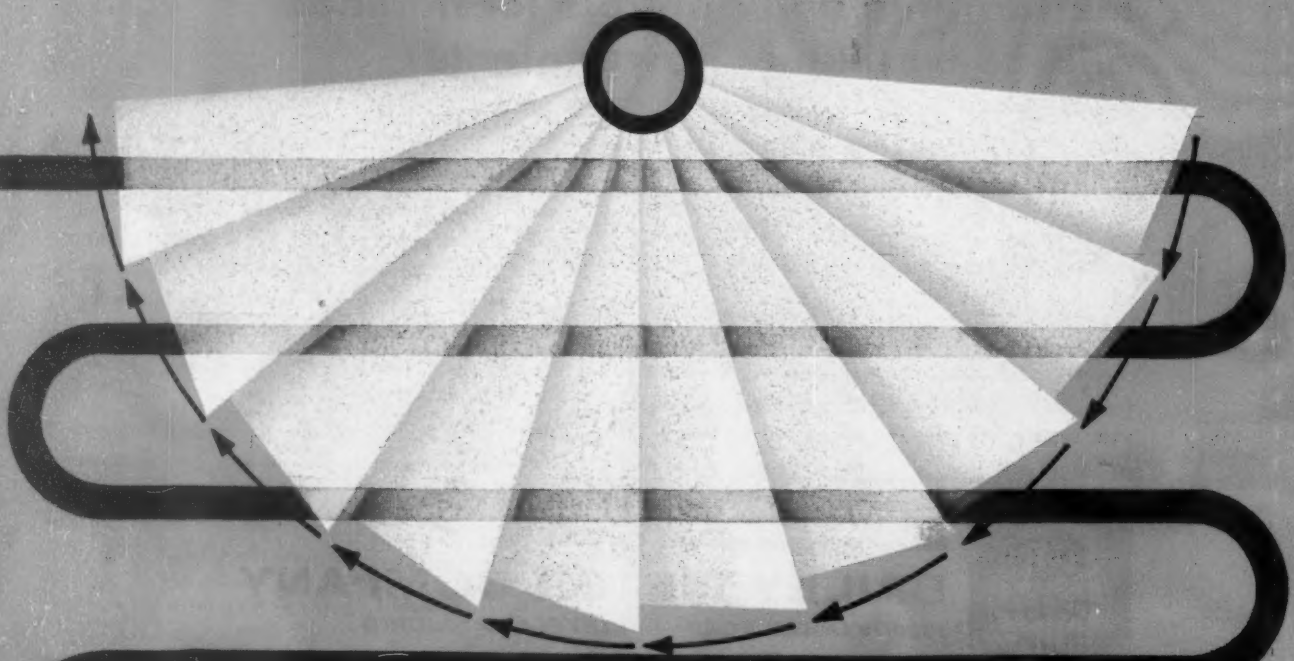

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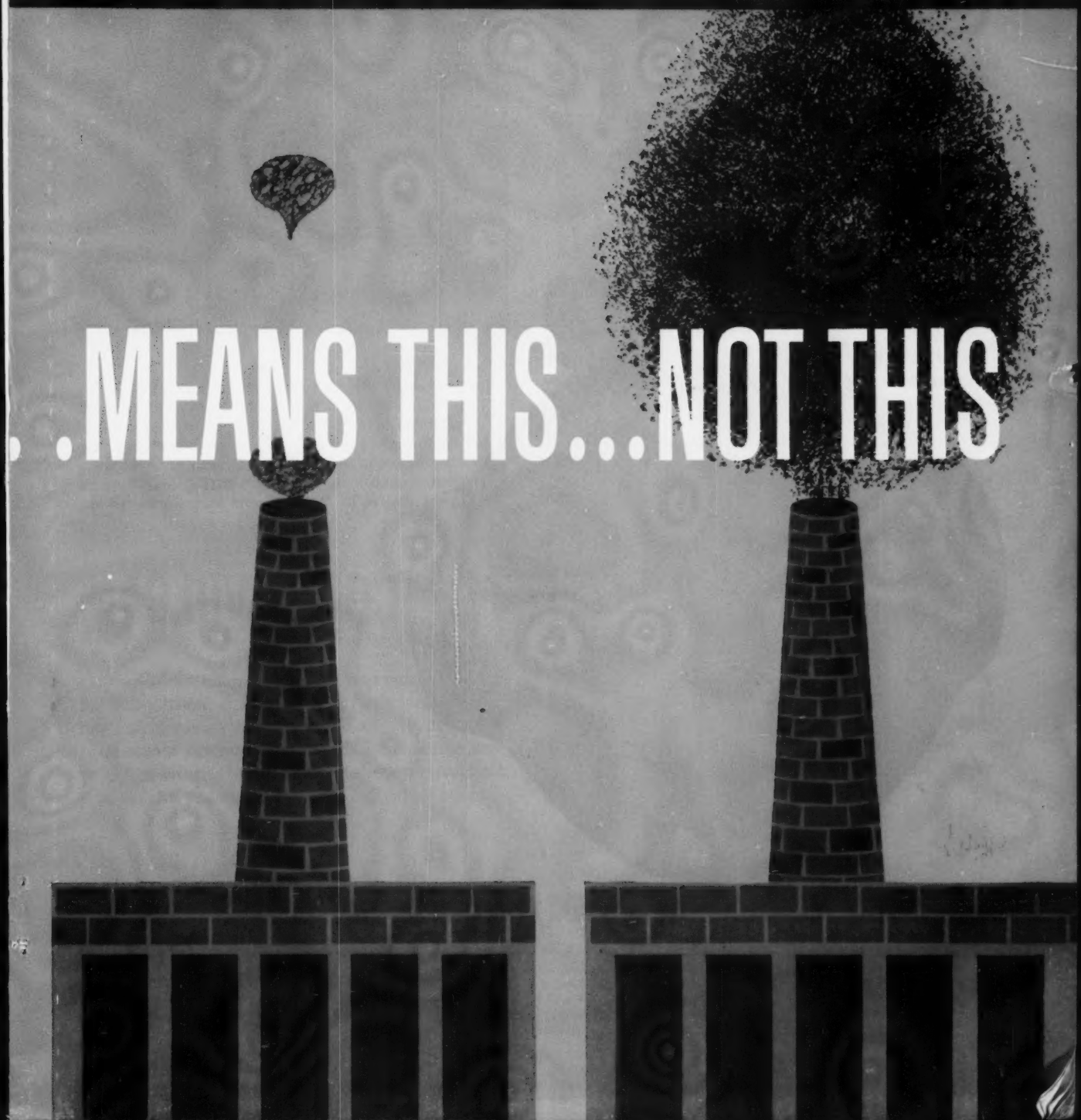

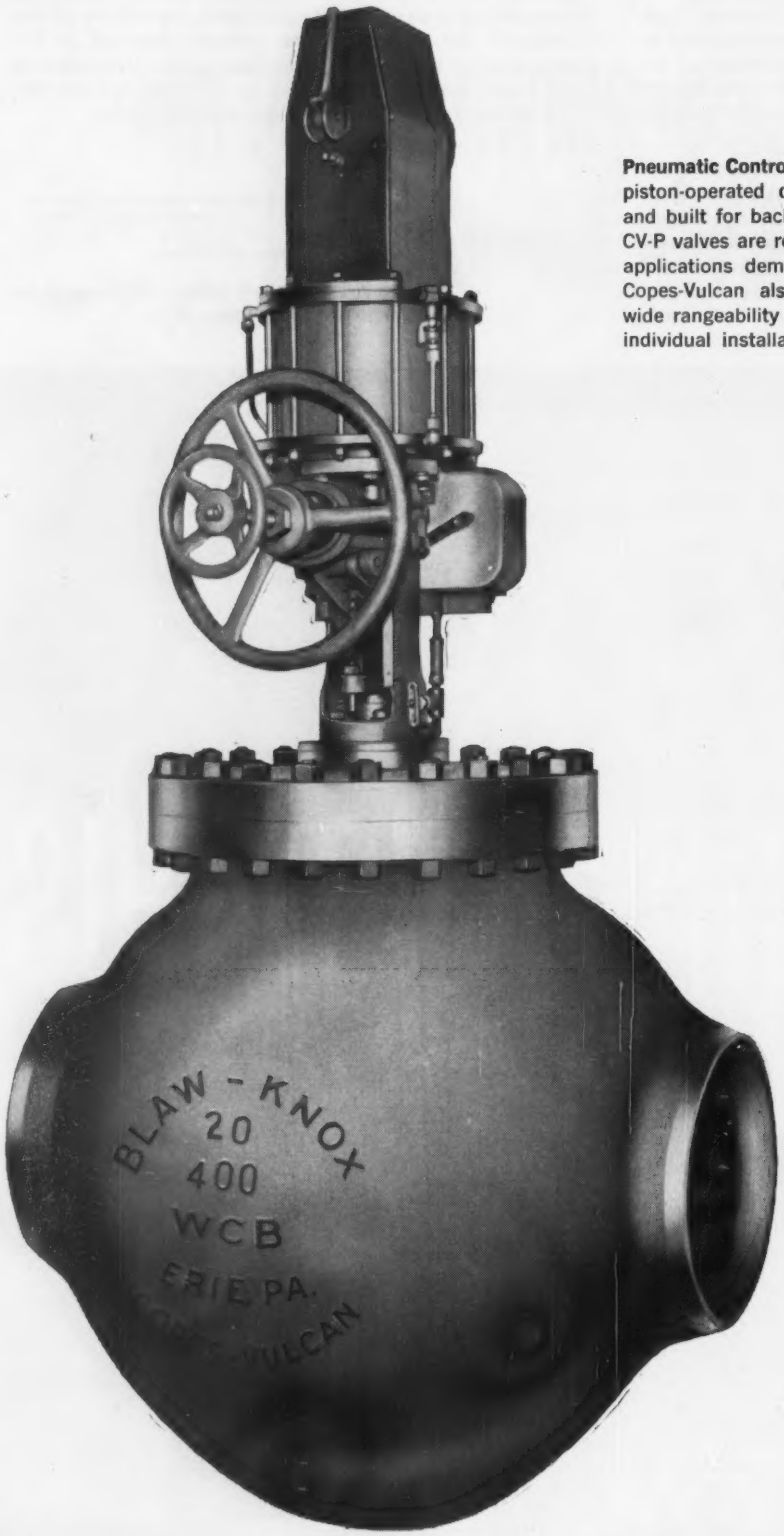


**Pneumatic Control Valves**—This 20-inch, 400-psig pneumatic piston-operated double-seated control valve was designed and built for back-pressure service in a utility station. Type CV-P valves are recommended for flow- and pressure-control applications demanding the finest valves money can buy. Copes-Vulcan also offers diaphragm-operated valves with wide rangeability and control characteristics tailored for the individual installation.

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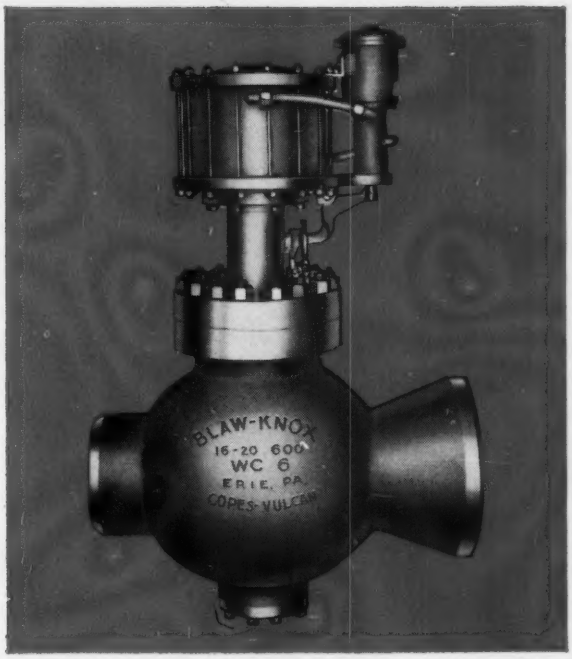
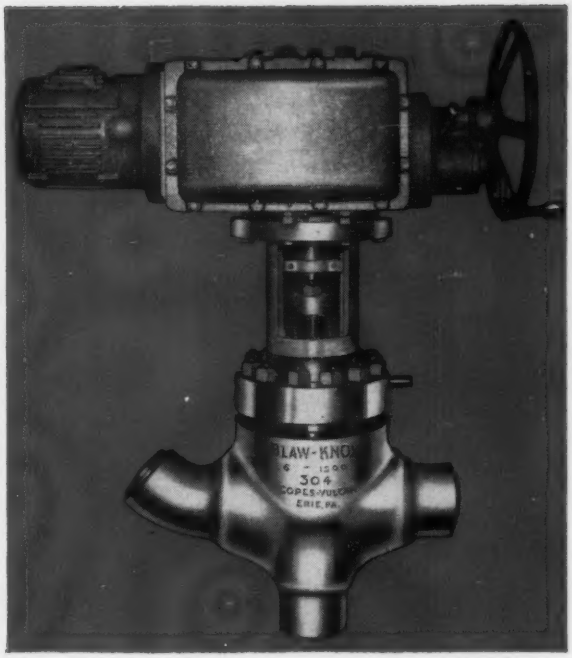



**Hydraulic Control Valves**—This 600-psig hydraulically-operated control valve, with 16-inch inlet, 20-inch outlet and 2½-inch stroke was designed and built for steam-dump in 80 milliseconds and precise back-pressure control. Copes-Vulcan offers valves in sizes up to 20-inch, and in pressure standards up to 2500-psig. They may be single- or double-seated. They can handle pressure drops up to 2000 psig.




**Nuclear Valves**—This 6-inch, 1500-psig motor-operated three-way selector valve for use in a stationary nuclear power plant was built of stainless steel for primary-fluid relief service. The unique design reflects the engineering capability offered by Copes-Vulcan for the solution of the most difficult problems encountered in both nuclear and conventional power stations.

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Copes-Vulcan offers equipment and control systems for boiler cleaning, combustion, feedwater, desuperheating, pressure reducing, and superheat and reheat steam temperatures. Each is available separately, or as an integral part of a single control package, custom-engineered to meet individual needs.

Copes-Vulcan also offers special valves for applications in conventional and nuclear power plants on land and sea. Like all Copes-Vulcan products, they are backed by experience gained in serving the power industry for more than half a century. Copes-Vulcan Division, Erie 4, Pennsylvania.

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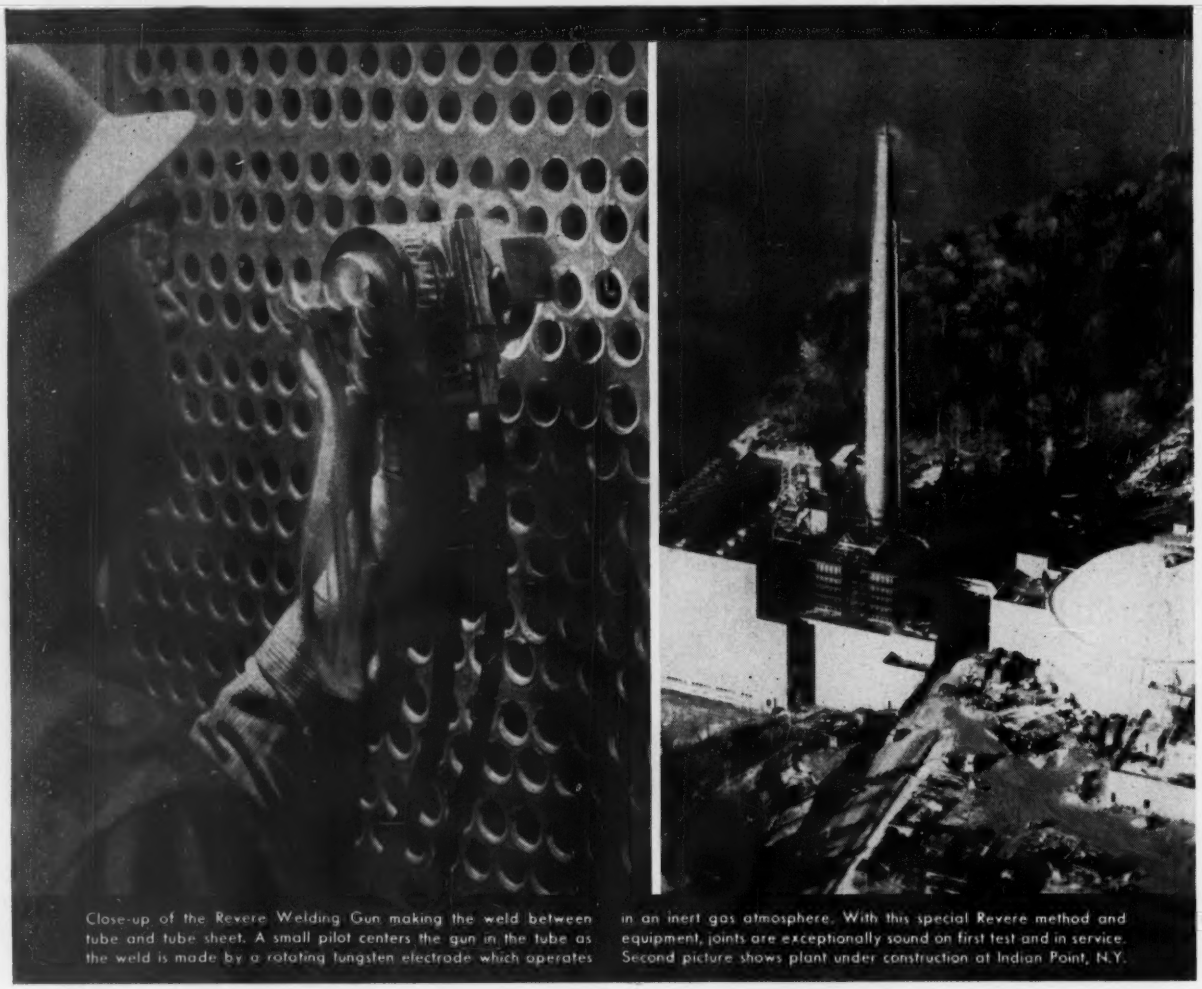


Close-up of the Revere Welding Gun making the weld between tube and tube sheet. A small pilot centers the gun in the tube as the weld is made by a rotating tungsten electrode which operates in an inert gas atmosphere. With this special Revere method and equipment, joints are exceptionally sound on first test and in service. Second picture shows plant under construction at Indian Point, N.Y.

# HOW CONDENSER TUBES— AVOID CONTAMINATION

## Revere Welding Gun* Used to Join 179 miles of Revere Tube to 8 Tube Sheets at Con Edison's Indian Point Atom-Powered 275,000 KW Unit

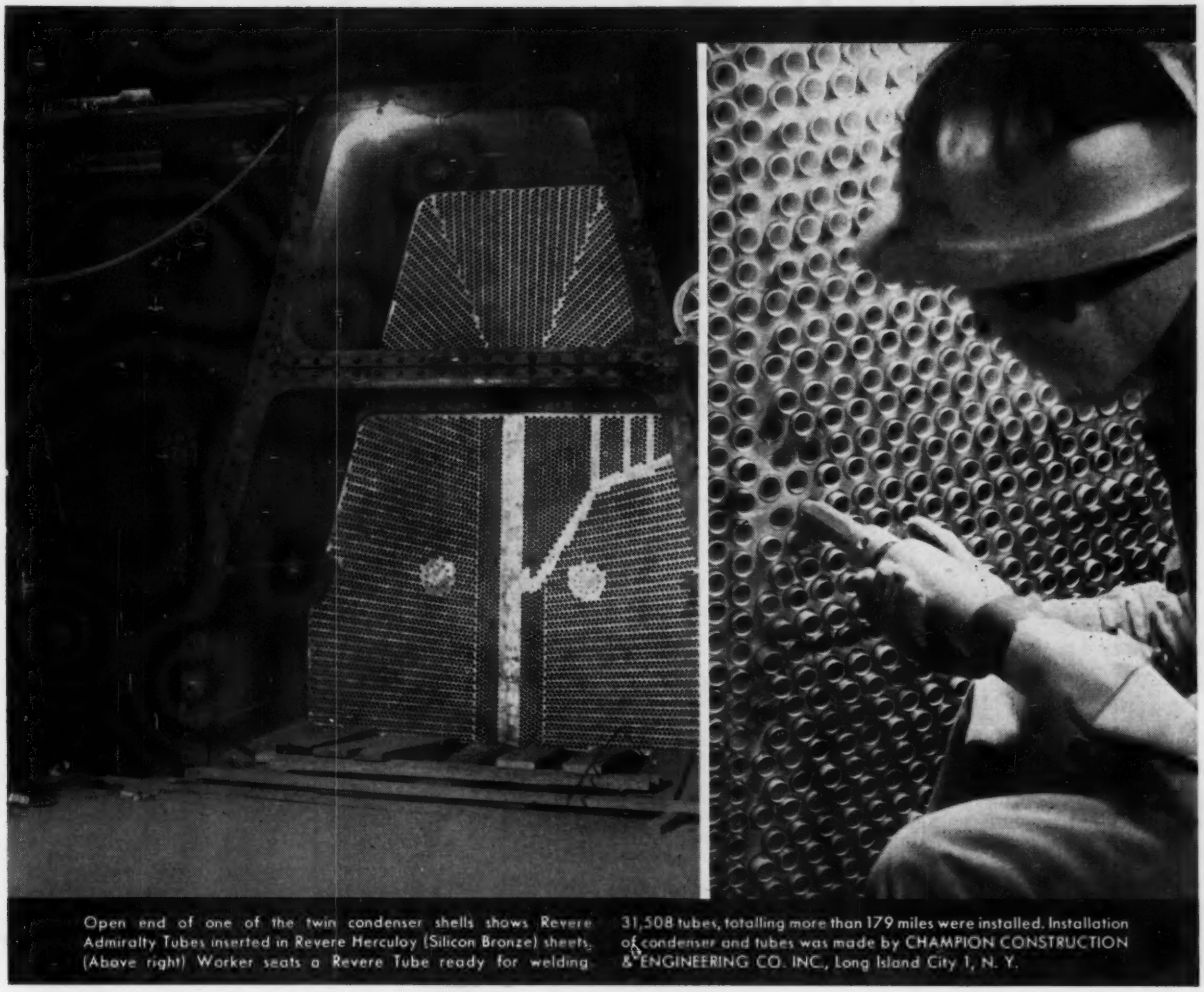
Later this year, Consolidated Edison will begin feeding power to its system from the $100,000,000 Indian Point, N. Y. generating plant, the largest atomic-fueled generating plant in America. An advanced type of Ingersoll-Rand Twin-Shell Surface Condenser serves this new 275,000 KW plant, and each of its thousands of Revere Condenser Tubes were *welded* into place, using the Revere Automatic Welding Gun.

Welding was used to assure absolute freedom from leaks between tubes and sheets—vital because of the low chloride requirements for the secondary water system at Indian Point.

This newest method of securing condenser tubes used techniques and equipment also used aboard the world's

*Pat. Pending

Integral Finned Tube • Bimetal Tube • Dual Gauge Tube • Instrumentation Tube • Condenser Tubes in Cupro-Nickel, Aluminum Brass, Admiralty, Herculoy (Silicon-Bronze), Arsenical Copper, Muntz Metal And Other Alloys • Aluminum Tube, Sheet And Extrusions • Small And Large Plates in Cupro-Nickel, Copper, Herculoy, Muntz Metal, Naval Brass And Admiralty • Low Carbon Steel Heat Exchanger Tube To ASTM Spec. A-214 And A-334 Grade "C" • Boiler Tube To ASTM Spec. A-178



Open end of one of the twin condenser shells shows Revere Admiralty Tubes inserted in Revere Herculoy (Silicon Bronze) sheets. (Above right) Worker seats a Revere Tube ready for welding. 31,508 tubes, totalling more than 179 miles were installed. Installation of condenser and tubes was made by CHAMPION CONSTRUCTION & ENGINEERING CO. INC., Long Island City 1, N. Y.

# WELDED IN PLACE— AT NUCLEAR POWER PLANT

first nuclear-powered merchant vessel, the N.S. Savannah.

At Indian Point, 473,500 lbs. of Revere Admiralty Tubes, ⅞" O.D., 18 BWG X 30' long are used; selected because this alloy best suits water conditions found at the site. These tubes are welded into 8 Tube Sheets fabricated of 1⅜" thick Revere Herculoy, the silicon bronze with the strength of mild steel and the corrosion-resistant properties of copper.

### *Revere Automatic Welding Gun Used*

Each of the more than 60,000 joints between the tubes and the sheets were made using the Revere Welding Gun and Revere-developed techniques. As a result, sound leak-proof joints were produced.

Revere produces condenser tubes in all of the standard condenser tube alloys, in aluminum and aluminum alloys, and in welded carbon and stainless steels. Integral finned copper-base alloy tubes are also produced. Take advantage of these metals and Revere's experience by calling Revere today.

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*(Advertisement)*

# Rockwell-Edward Nuclear

**Shippingport, Pennsylvania, 1961: After more than three years of operation, it is possible to report in depth on the manufacture and performance of Rockwell-Edward high-pressure steel valves built for Shippingport, pioneer nuclear power generating station. This report deals with two areas:**

1. *How Rockwell-Edward quality control met rigid Shippingport requirements.*
2. *How relatively standard design Edward valves have performed in Shippingport nuclear service since startup in 1957.*

### Quality Control

Quality control of the highest order in building steel nuclear valves for the Duquesne Light Company-operated Shippingport Station brought the valve maker's art to new heights. These valves, for the primary coolant system in the first full-scale nuclear power generating station, were furnished by Edward Valves in 1-inch to 18-inch sizes. Since no valves had ever been called upon to perform in such service before and since slightest valve failure could have consequences far more serious than any possible before, Edward was called upon to apply every conceivable technique of quality control known.

From the very beginning, physical and chemical analysis of all component materials was made on every lot and every heat. Statistical lot testing was not adequate.

### Testing and Measurement

Normal valve making requires only that certain diameters and angles be watched to critical tolerances. But for the Shippingport valves, every dimension that could be measured was measured and checked to tolerances of thousandths of an inch. All forged steel valve bodies were ultrasonically tested to pick out body flaws that could lead to leaks or stress concentrations. Ultrasonic testing is not ordinarily warranted for valves as small as 1-inch size. After Stellite inlays were laid and machined for seating surfaces, dye penetrants were used to detect porosity, surface flaws, holes and crevices.

All internal surfaces were inspected with a Boroscope. Roughness was held to 30 microinches.

### Precision and Cleanliness

Though lapping is usually reserved for valves destined for gas service, the Shippingport valve seats were hand lapped to a maximum roughness of 16 to 30 microinches, rms. All internal surfaces exposed to fluid were polished to 125 microinches, rms. Such fine internal finishing is very difficult on small valves, but had to be done. All internal surfaces were inspected with Boroscopes.

All cleaning and degreasing as well as final assembly were done in the "clean room". All personnel wore lint-free coveralls. No smoking was permitted.

### Final Tests

Two-hour hydrostatic tests, back seat tests, and packing tests were done in the "clean room," also. After tests, the completed valves were again oven dried in nitrogen and inspected with a Boroscope for cleanliness, porosity and surface finish. These inspections were made by Edward and representatives of Westinghouse Electric Corp. and the United States Navy. Valves were sealed in polyethylene bags and then removed from the "clean room" for packing according to military standards.

Experience with rigid quality control conditions such as these is hardly routine. But it illustrates what a valve maker can do with his standard line.

### Performance Record

Not a single complaint has been received on any of the more than 100 Edward one-inch and two-inch forged steel globe stop valves used in the high-pressure primary reactor system, or on the four 18-inch tilting disk check valves used in the primary coolant pump discharge lines.

A few of the globe stop valves have required routine seat maintenance, but no more than would be expected. Leakage through the packing of the globe stop valves has been consistently within expected limits . . . that

*(Advertisement)*

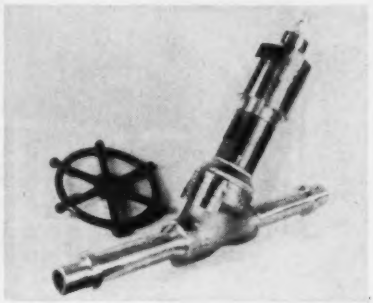
# Valve Report:

is, so minute as to be of no consequence. In fact, although many of the Edward globe stop valves were furnished with weldable caps as a precaution against packing leakage, the caps have been welded into place only on those valves in relatively inaccessible areas near the reactor.

Forged steel valves for Shippingport—and for the Westinghouse Belgian reactor and other nuclear projects—were individually sealed in plastic bags.

In furnishing high-pressure steel valves for virtually every U.S. nuclear power plant built to date, Edward has demonstrated that excellence of design and manufacture is *the* important ingredient in nuclear power valving, just as it has been in conventional power valving for more than fifty years. They have proved that there *are* important differences in various steel valve lines . . . and that Edward customers get the benefit of these differences.

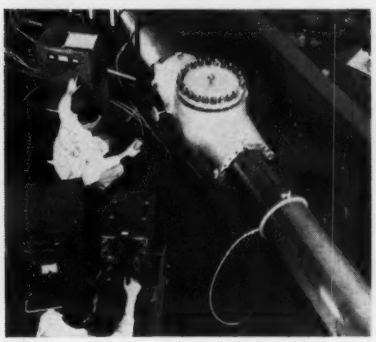
Edward builds a complete line of forged and cast steel valves from ¼" to 24" for power, industrial, marine, and petroleum services. For more information, contact your Edward Representative, or write Edward Valves, Inc., 1230 West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 438 St. Peter Street, Montreal.

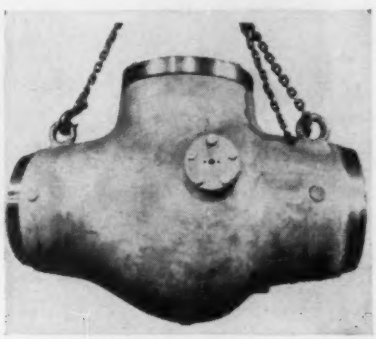


This valve is typical of smaller capped forged steel stop valves furnished for Shippingport. Cap has been screwed into position on bonnet but has not been seal-welded.

## Big Cast Steel Valves, Too

The development of suitable check valves for pump discharge service in primary coolant loops of large pressurized water reactors has been substantially advanced by exhaustive flow testing begun in the Edward research laboratories in the 1940's. Equipped with a flow test loop circulating up to 2,000,000 lb/hr of water and capable of flow reversal in a fraction of a second, Edward research engineers have been able to simulate actual service conditions and develop check valve designs with superior opening and flowing characteristics together with the best possible non-slam features upon flow reversal. Full size prototypes of Shippingport, N. S. Savannah, Enrico Fermi, and Indian Point primary loop check valves were tested with this equipment.



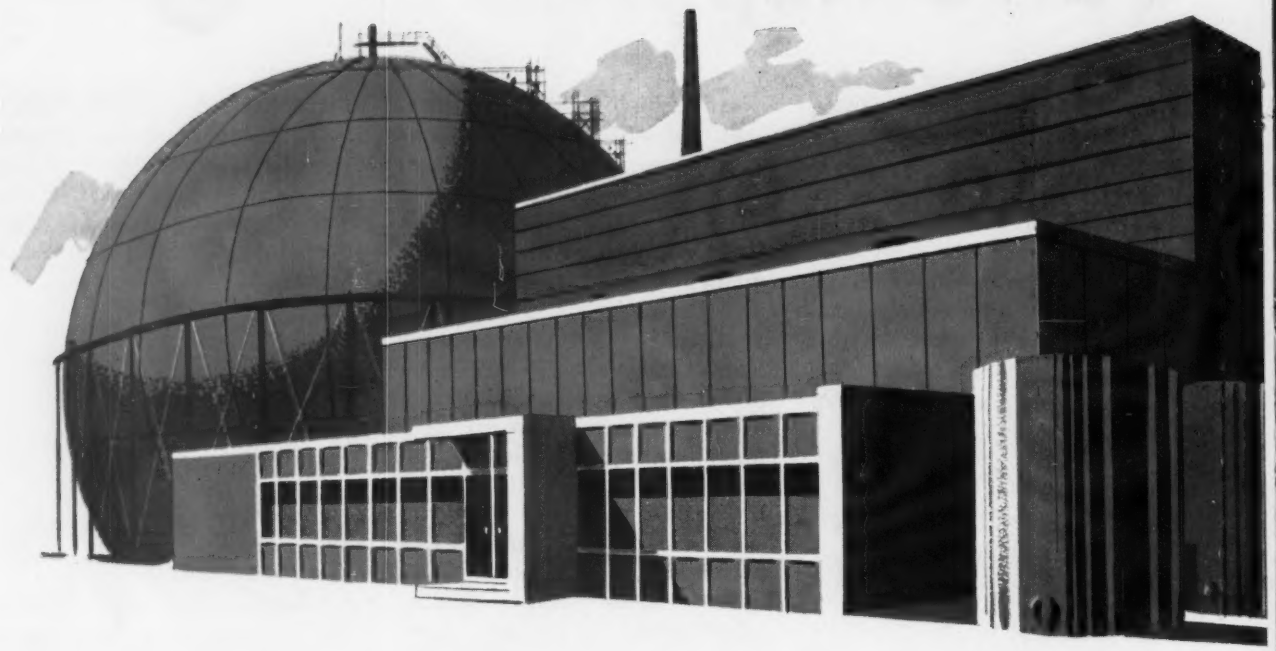


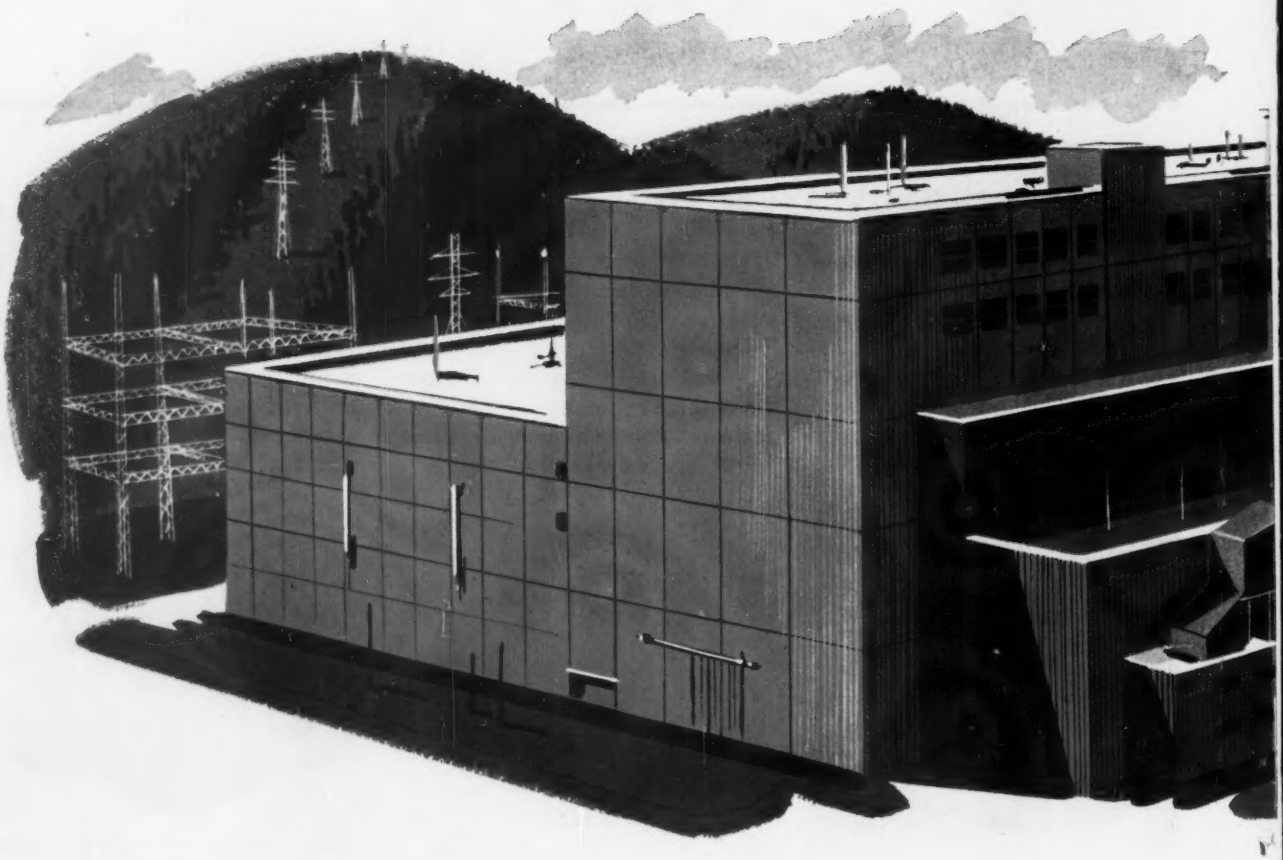
6104

Large 18-inch cast steel stainless steel check valves for Shippingport (left) received same meticulous attention as small forged valves . . . and have functioned with equal dependability since going into service in late 1957.

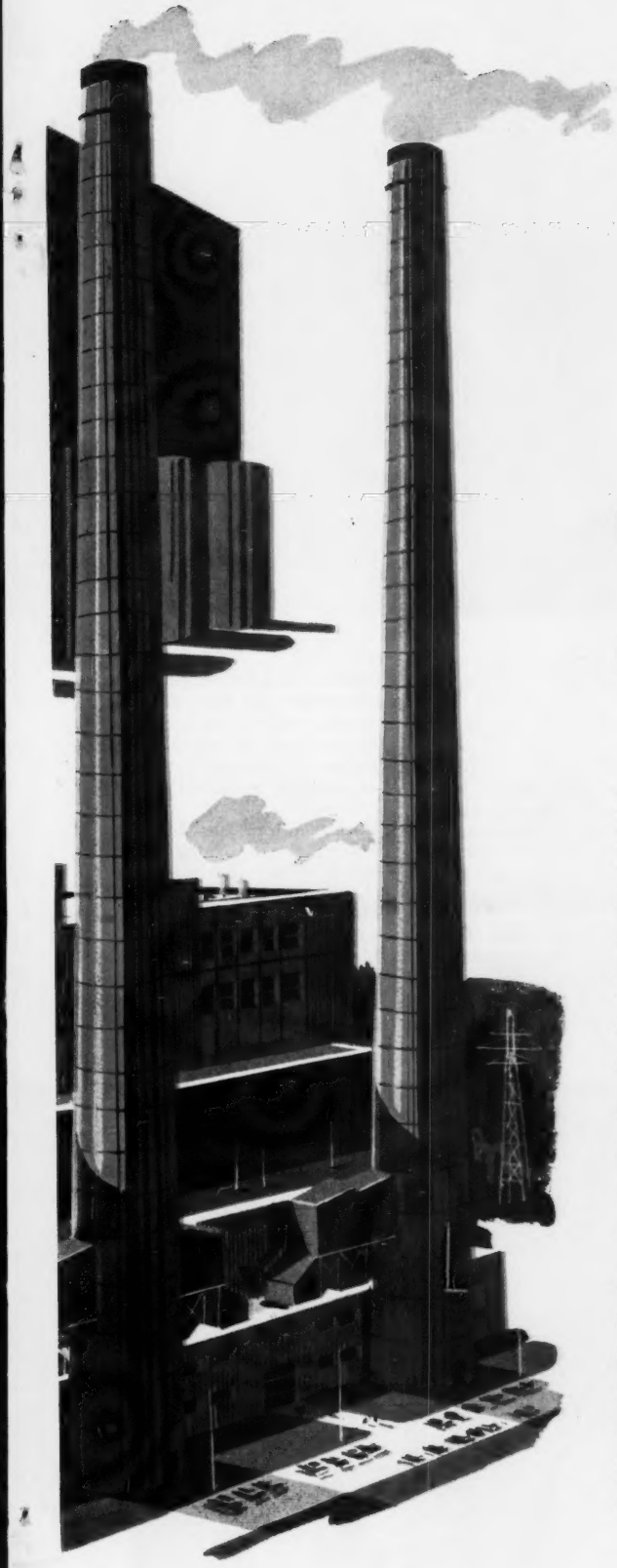
Other large Rockwell-Edward stainless steel valves were built for primary coolant systems of Babcock & Wilcox N.S. Savannah (center) and Indian Point (right) reactors.

EDWARD STEEL VALVES
another fine product by
ROCKWELL





**POWER PLANT PRODUCTS HEAT ENGINEERED BY FOSTER WHEELER:**
**Central Station and Industrial Steam Generators • Steam Condensers and Pumps • Cooling Towers**
**Pulverized Fuel Systems • Feedwater Heaters • Packaged Steam Generators • Nuclear Components**



# Whatever the challenge

Atomic power plants were not achieved overnight. In a large measure they were built on fundamental knowledge developed for conventional steam power plants.

Thoroughly grounded in these fundamentals, Foster Wheeler has designed, engineered and built more nuclear steam generators than any other firm in the world.

Today, nuclear-born technology at Foster Wheeler contributes directly to superior equipment of every description . . . equipment that earns a better return on plant investment.

Foster Wheeler designs and builds utility, industrial and marine steam generators; pulverized fuel systems, steam condensers, feedwater heaters, nuclear components, cooling towers, pressure vessels, oil refineries; chemical, petro-chemical and industrial processing plants. Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, New York.

FOSTER FW WHEELER

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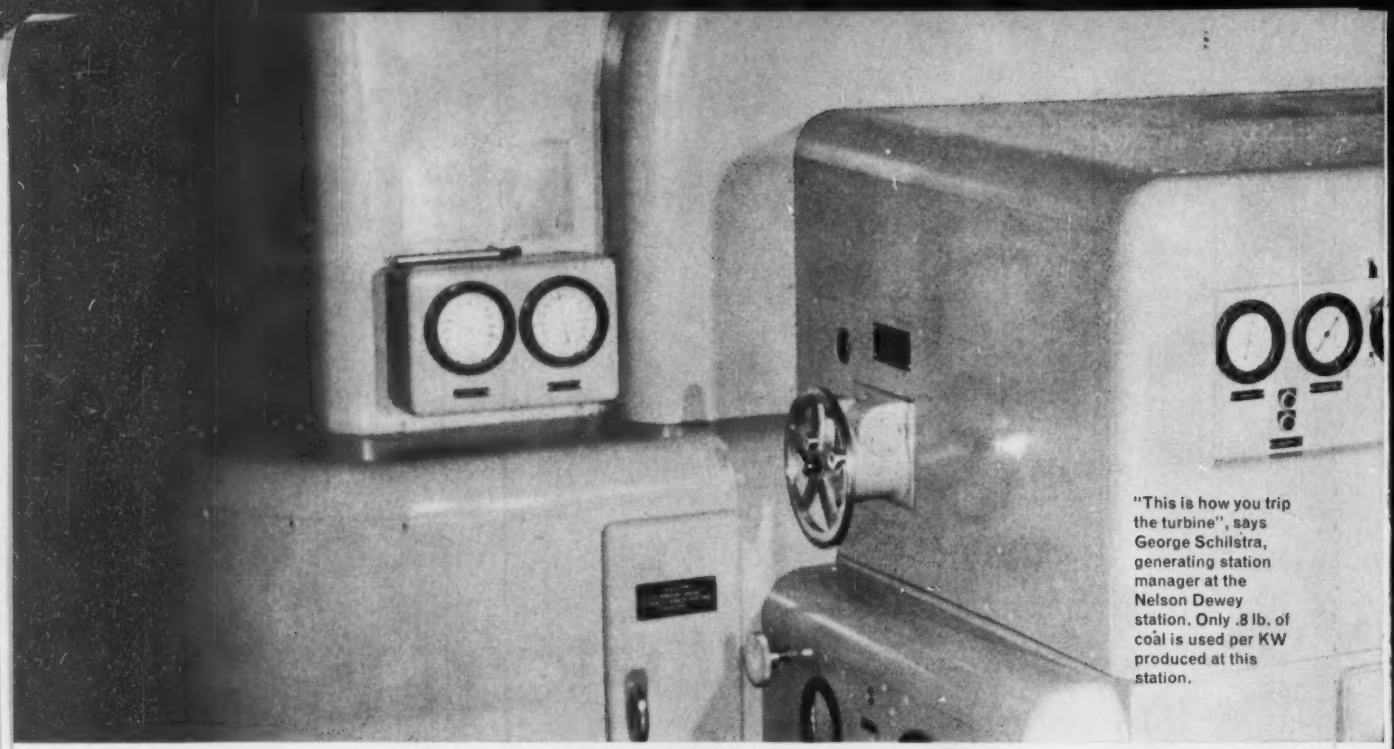
331

For more facts circle 775 on Reader Service card, p 207

Circle 776 on Reader Service card for following ad ➤



"This is how you trip the turbine", says George Schilstra, generating station manager at the Nelson Dewey station. Only .8 lb. of coal is used per KW produced at this station.

BY R. C. "ROLLY" BLEIMEHL

**About the Author.** Rolly Bleimehl has been providing technical service on lubrication to customers of our parent company for fifteen years. He has a mechanical engineering degree from Iowa State College and has completed the Company's Sales Engineering School at Whiting, Indiana.

★ ★ ★

In 1954, when the first of two 75,000 KW turbines went into service at Wisconsin Power & Light Company Rock River generating station, Beloit, management had to make a decision on a turbine oil. Two factors helped them decide in favor of NONPAREIL Turbine Oil: (1) NONPAREIL's performance history and (2) the technical service available from American Oil Company.

Performance history: Each fill of NONPAREIL Turbine Oil carries with it a life-of-turbine guarantee. This means that if, during the life of the turbine, the neutralization number of the oil ever rises above the low limit of 0.15, the oil will be replaced free of charge. Some fills of NONPAREIL Oil have been in service more than 35 years under this life-of-turbine guarantee.

Technical service: I'm located at Madison, only a short distance from Beloit. Thus, I'm always handy to make periodic calls at the station to answer questions about the oil. And we take samples of the oil regularly for analysis at our Whiting, Indiana, laboratory (at no expense to the utility).

Putting these two together—product performance and technical service—Wisconsin Power & Light Company decided it made good sense to specify NONPAREIL Turbine Oil. The satisfactory performance of the oil in the first turbine at Beloit helped the management decide on

This is
AMERICAN OIL COMPANY
in action

# Technical Service, Product Performance

it for the second 75,000 KW unit when it was installed in 1955. For the same reason management selected NONPAREIL when their 100,000 KW turbine went into service at the Nelson Dewey station, Cassville, Wisconsin, in 1959.

Get more information about NONPAREIL Turbine Oil and about the lubrication technical service that is available. Phone your nearby American Oil Company office.

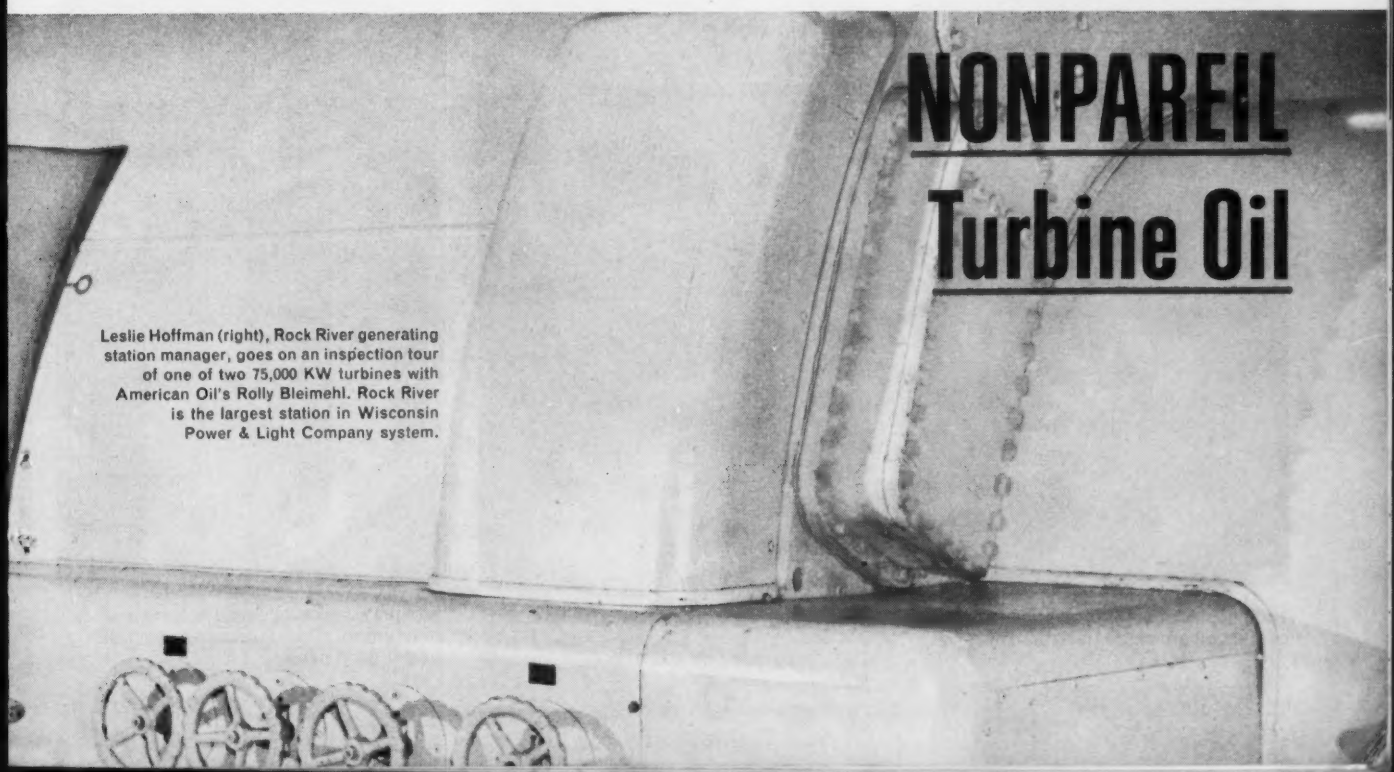
*Quick facts about* **NONPAREIL Turbine Oil**

- Will not permit formation of harmful acids.
- Will not permit formation of sludge or oil varnish.
- Will maintain good demulsibility or water-separating characteristics.
- Has high resistance to foaming.
- Contains adequate rust inhibitor.

AMERICAN

**AMERICAN OIL COMPANY**
910 S. Michigan Ave., Chicago 80, Ill.

# --two reasons why this utility selected



# NONPAREIL Turbine Oil

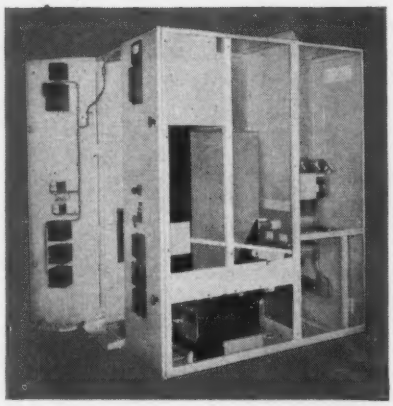
Leslie Hoffman (right), Rock River generating station manager, goes on an inspection tour of one of two 75,000 KW turbines with American Oil's Rolly Bleimehl. Rock River is the largest station in Wisconsin Power & Light Company system.

# More features make Westinghouse metal-clad switchgear

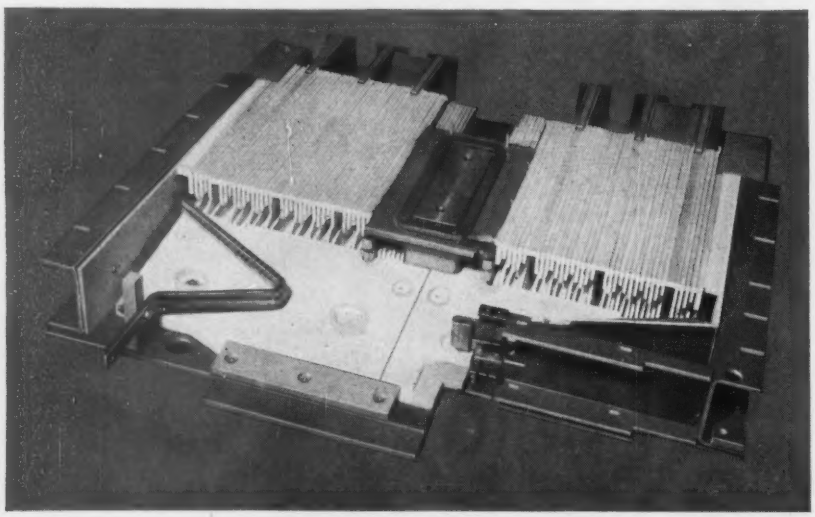
Westinghouse metal-clad switchgear is design proved in the Westinghouse High Power Laboratory. It meets all industrial, electric utility, commercial, institutional, and other needs for 75 to 1000 mva service inclusive, 4.16 through 13.8 kv.

Check below for advantages of this equipment that are of major importance to you.

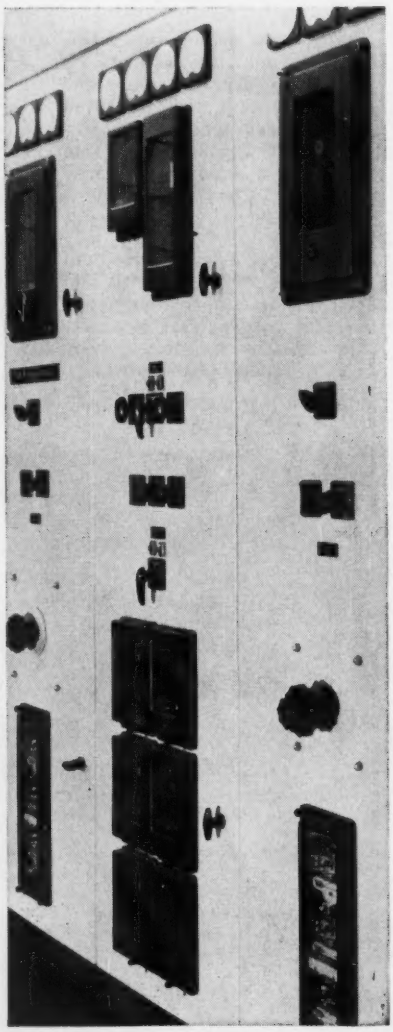
For further information, call your Westinghouse representative or write for a copy of Descriptive Bulletin 32-250 to Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. *You can be sure . . . if it's Westinghouse.*



Balanced insulation protection is provided by the exclusive "Limitrak" insulation system on bus supports, arc chute enclosure and breaker bushings.

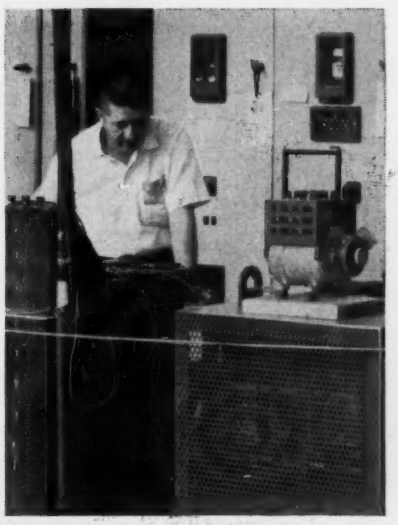


Fast, positive circuit protection is provided by the De-ion principle of arc interruption with center coil arc chute design.

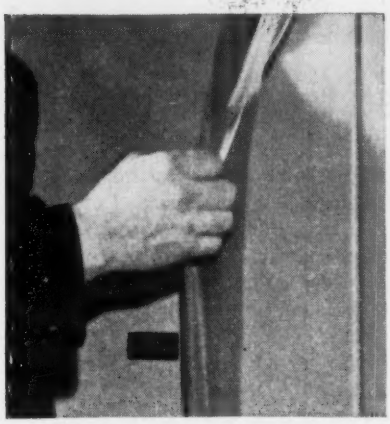


Adequate space for varied relaying and instrumentation is assured by full height front panels.

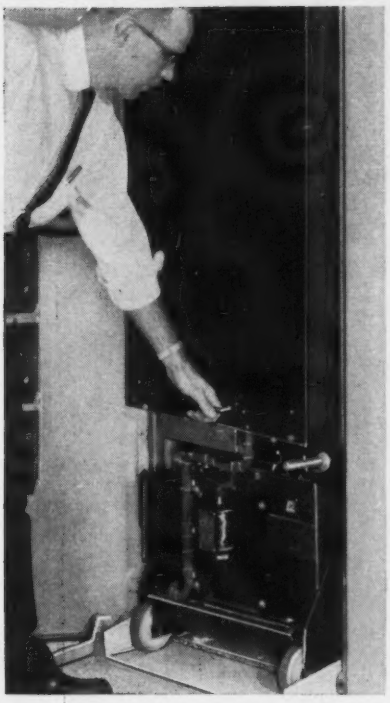
# your best buy



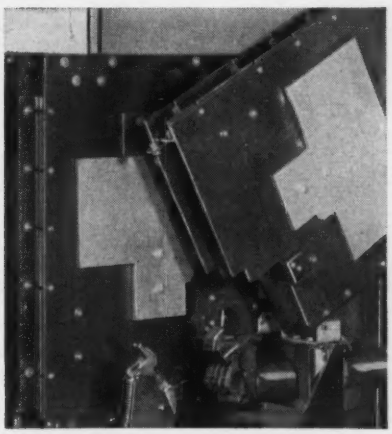
Proper component functioning is verified by a continuing program of production inspection and testing.



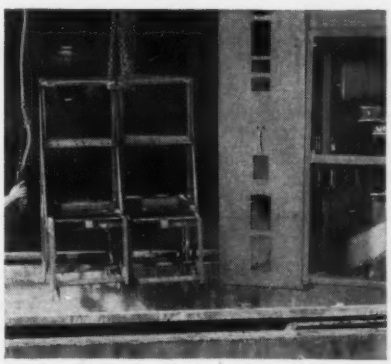
Front panel is protected during assembly, shipment and installation by strippable plastic coating.



Simple, quick inspection, maintenance and replacement of DH breakers is made possible by horizontal drawout construction.

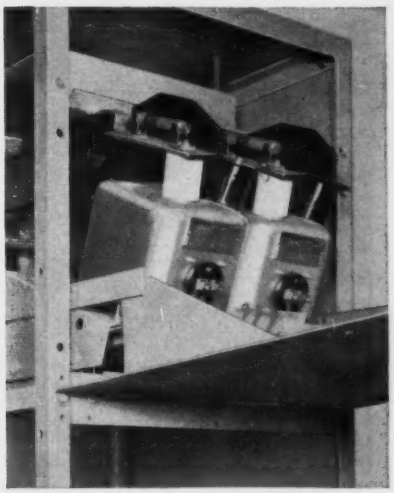


Hinged arc chute permits easy tilting for inspection and maintenance of contacts with DH breaker in drawout position.



Thorough phosphatizing and priming treatment safeguards against corrosion and provides a superior base for finish coat.

Complete joint sealing with polyester compound at main contact supports and main bus provides full insulation.



Personnel are protected by separate compartment drawout-type mounting of potential transformers.

Westinghouse

J-61014



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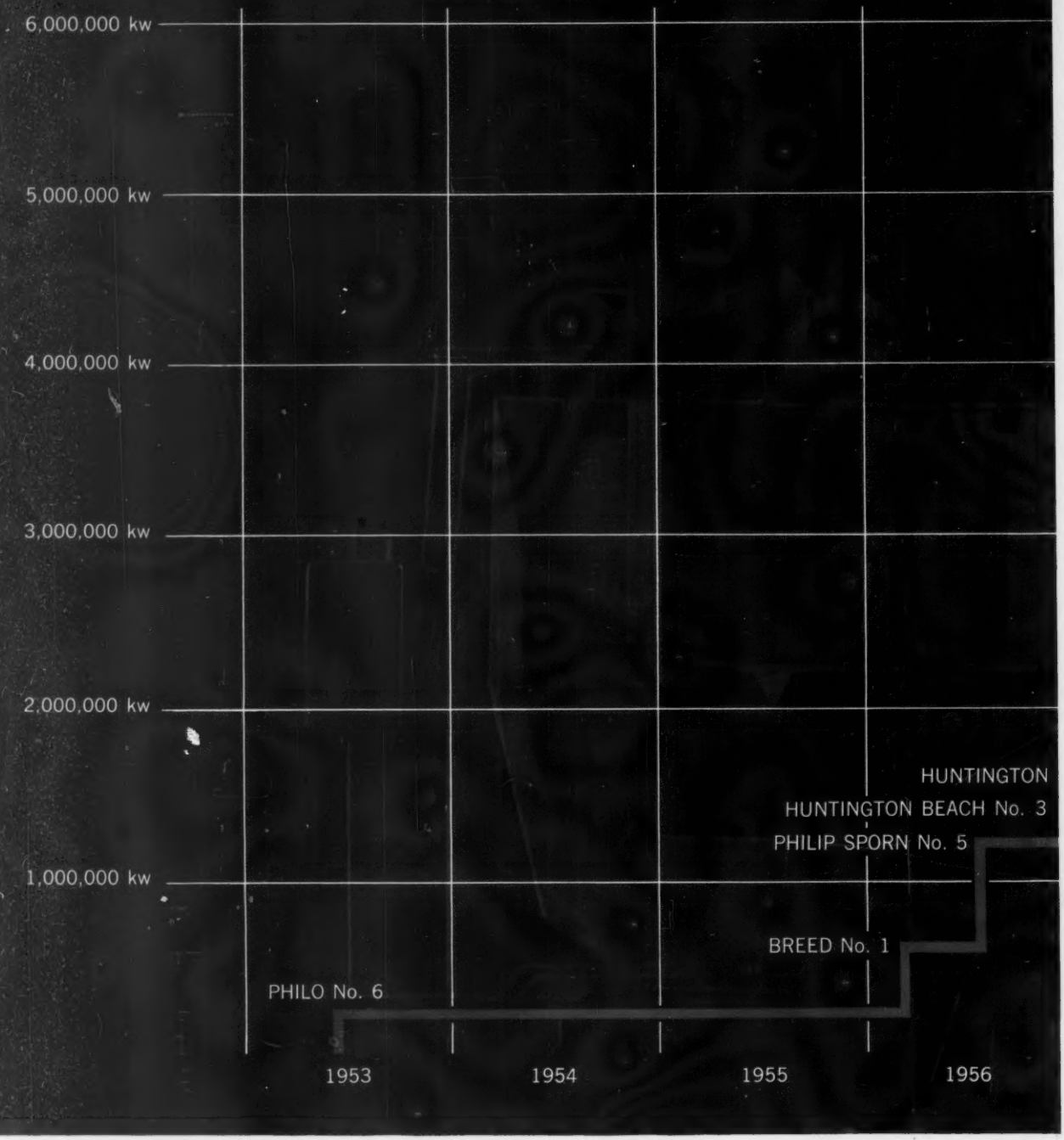
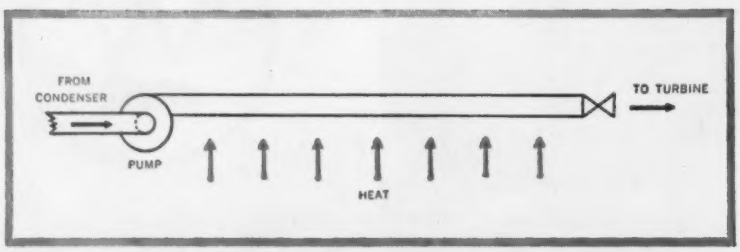



# Acceptance for B&W Universal Pressure steam generator

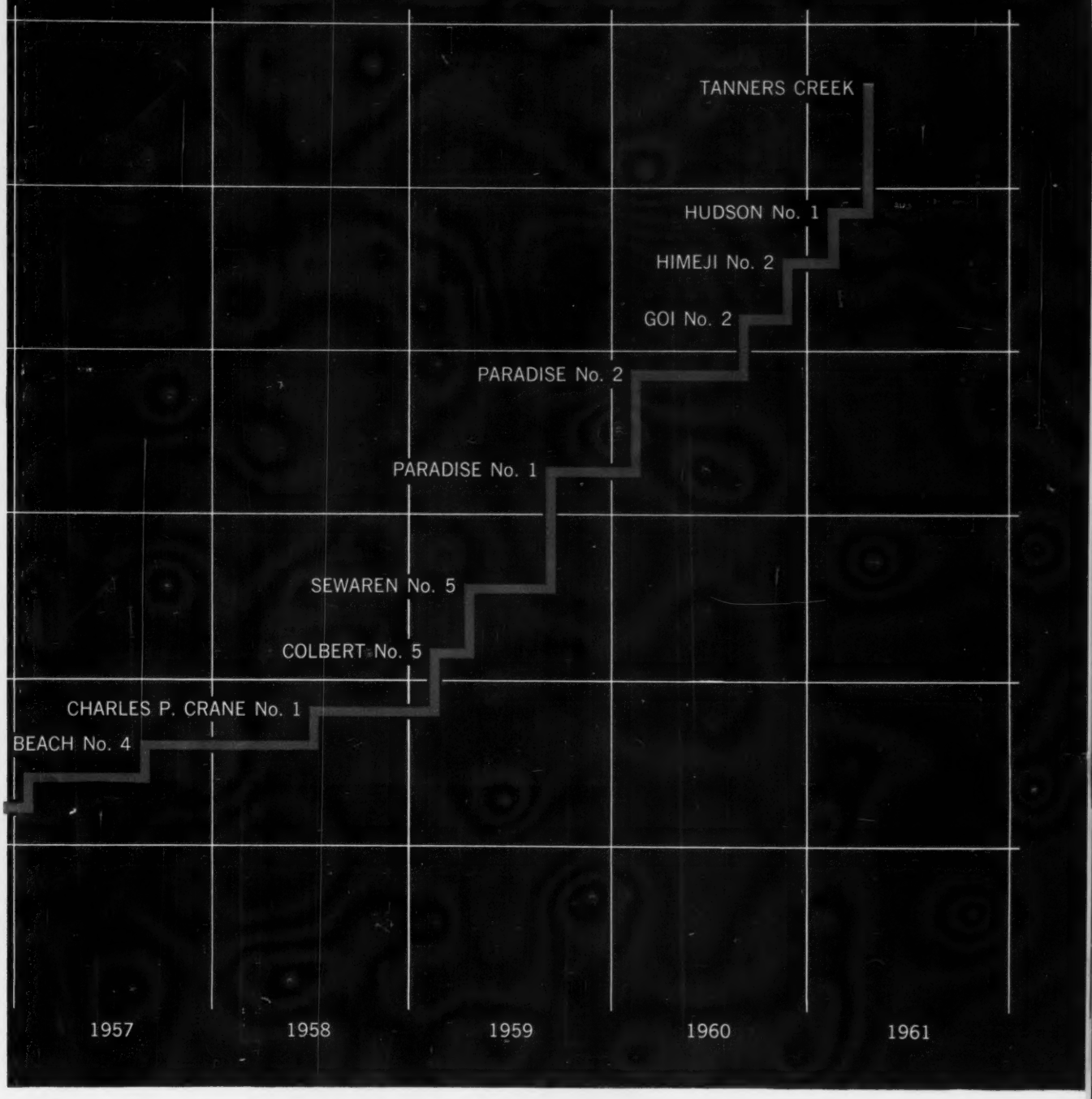



The Universal Pressure steam generator is a true once-through boiler. In effect, a long tube. Water enters at one end, picks up heat, changes to steam, becomes superheated and leaves the other end at the desired temperature and pressure.

Fourteen Universal Pressure steam generators are now installed or on order from Babcock & Wilcox. Five will operate at turbine throttle pressures of 3500 psi and higher. Nine are for operation at 2400 psi.

These 14 plants represent a three-quarter of a billion dollar investment by the utility industry.

What is behind the trend to the Universal Pressure boiler? There are four major reasons.




# keeps growing. Orders now top 5,500,000 kw.

1. Increased availability. The Universal Pressure steam generator is a true once-through unit. Its inherent simplicity has resulted in 95 per cent boiler availabilities.

2. Increased economy. Ability to maintain steam temperatures over the entire load range improves the plant's overall efficiency. B&W's flexible by-pass system permits start-ups with minimum fuel and economical low-load operation.

3. Lower maintenance costs. After trip-out, the Universal Pressure steam generator can be entered for maintenance in 2½ to 3 hours. Fast cold starts and hot restarts can be made without thermal shock to turbine parts or steam piping. The condensate polishing system provides maximum protection against boiler or turbine deposits. Gas conditioning minimizes superheater creep, corrosion, and slagging.

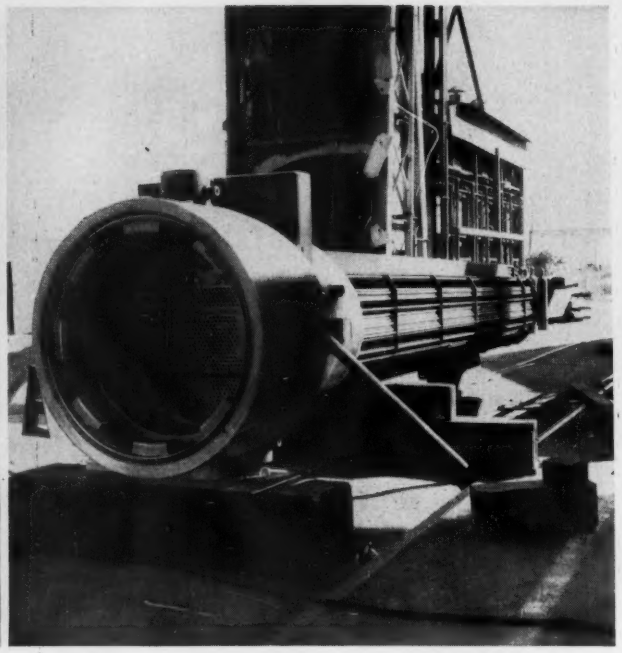
4. Reduced overall plant capital costs. A Universal Pressure steam generator weighs approximately 20% less than a drum boiler. Foundations can be smaller and less expensive. Less steel is required. Erection is simpler and faster.

For more information write to: The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

**Babcock & Wilcox**

**For more facts circle 788 on Reader Service card, p 197**

Using special type gun, average operator can make completely tight tube weld in less than 15 seconds.

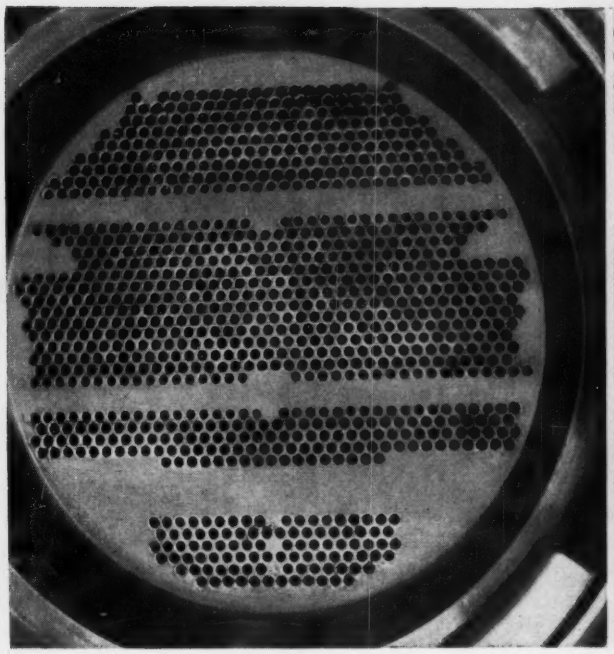


Head-on view of unit. Cufenloy-30 tubes are fabricated by special Phelps Dodge drawing and heat-treating process.

# PHELPS DODGE CUFENLOY-30 DUAL GAUGE TUBES WELDED INTO FEEDWATER HEATERS

*U-bent units combine new high strength alloy tubes and new tube jointing technique for superior heat transfer efficiency and dependability*

*Photographs: Courtesy of Southwestern Engineering Co.*



Close-up of tube sheet shows welded-in tubes in place. Incomplete or unsound welds are easily corrected by re-welding.

Rear view of high pressure feedwater heater unit shows configuration of Cufenloy-30, U-bent Dual Gauge tubing.

Dual Gauge tubes of Cufenloy-30, the new and weldable, drawn, stress-relieved copper nickel alloy developed by Phelps Dodge, have been welded into high pressure feedwater heaters constructed by Southwestern Engineering Co. for a West Coast utility.

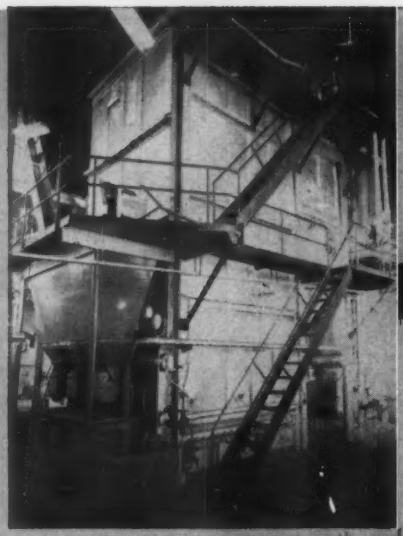
Cufenloy-30, containing nominally 70% copper and 30% nickel, is approved under the ASME Code, Case No. 1266, for unfired pressure vessels. This new alloy offers improved properties for OEM and retubing at a lower cost per bundle, yet without sacrifice of safety when substituted for 65/35 nickel copper alloy tubes. The Dual Gauge process provides a heavier wall thickness to compensate for thinning on outer portions of return bends.

Specially designed Phelps Dodge welding guns were used to weld these tubes to the tube sheets. This advanced method assures tighter tube joints with more positive, permanent protection against leakage. The guns are controlled by preset relays and timers that start, stop and regulate electrode motion, welding current and argon flow.

Whatever your tubing or re-tubing requirements, call on Phelps Dodge for highest quality products, research and technical advisory service—a complete program backed by more than 40 years of experience in the heat exchanger and condenser tube field.

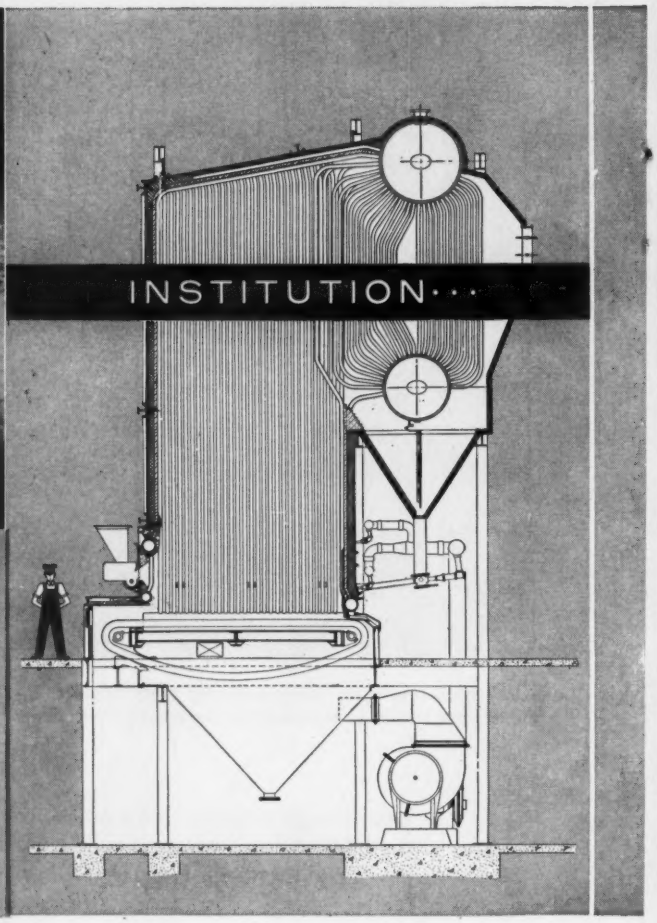
**PHELPS DODGE COPPER PRODUCTS**
CORPORATION
300 Park Avenue, New York 22, N. Y.

P MINE TO MARKET D



# ERIE CITY

## STOKER FIRED OPEN PASS STEAM GENERATORS




The single or open pass boiler lends itself to coal firing, particularly where part of the fuel is burned in suspension. The absence of baffles eliminates possible areas of maintenance; prevents any possibility of flue gases short circuiting, which causes a reduction in heat transfer; and provides a fixed flow area for the life of the boiler.

The absence of baffles also allows a smooth and even flow of gases through the convection zone at low velocities with no sharp gas turns, thus reducing the possibility of tube erosion. By eliminating the gas turns, the draft loss through the system is kept to a minimum and lower fan horsepower is required. Low draft losses through the convection zone also reduce side wall maintenance by eliminating the tendency of gases to be forced around the convection zone, through the side wall tile and insulation, to the boiler flue gas outlet. Soot blowers, if needed, are also kept to a minimum.

Open pass boilers, like other types, can be furnished with tangent water wall tube furnaces which permit the use of low ash fusion temperature coals.

Erie City Iron Works offers single responsibility by designing and manufacturing the Boiler — Stoker — Air Preheater — Economizer and Superheater. Write for Catalog SB 6111K

Capacity . . . . . 70,000 lbs./hr
Design Pressure . . . . . 250#
Operating Pressure . . . . . 160# Saturated
Firing . . . . . Erie City "Travagrate" Stoker

**Recent Users of OPEN PASS Boilers**

Minnesota Mining and Manufacturing Co.
Hastings, Minnesota

Hercules Powder Company
Gibbstown, New Jersey

Johns-Manville
Klamath Falls, Oregon

Ohio State University
Columbus, Ohio

Deere & Company
East Moline, Illinois

Union Carbide Company
South Charleston, West Virginia

Board of Public Utilities
Jamestown, New York

City of Greenwood
Greenwood, Mississippi

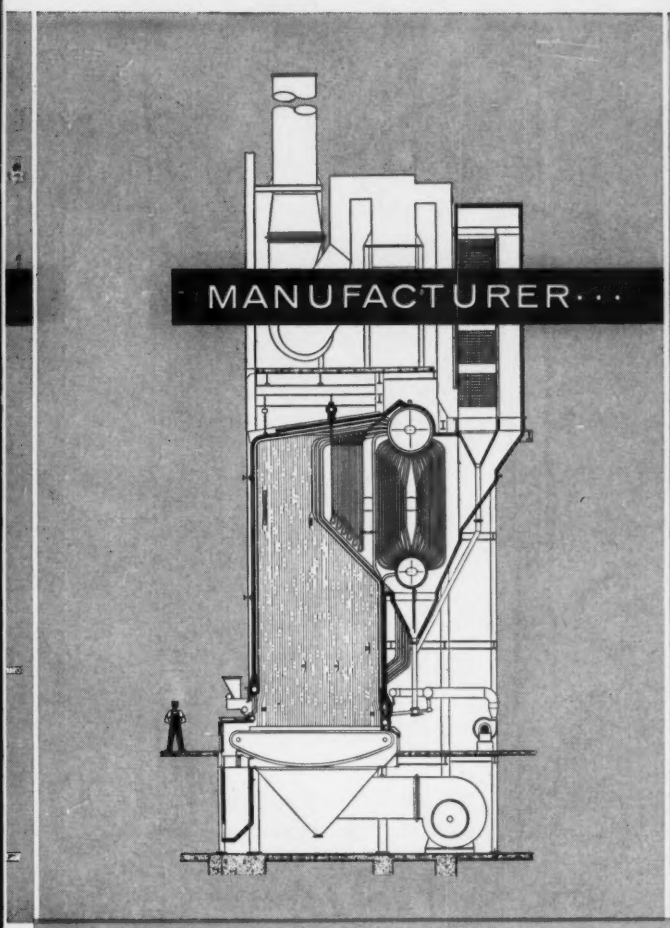
Municipal Light Plant
Peru, Illinois

Water and Light Commission
Virginia, Minnesota

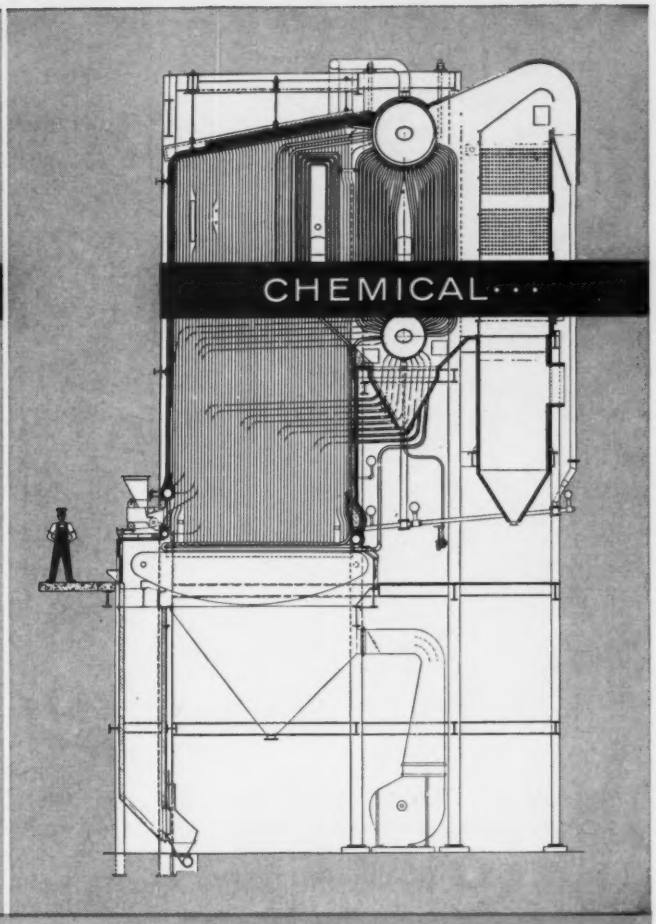
ERIE CITY Since 1840

## ERIE CITY IRON WORKS · Erie, Pennsylvania

• STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
• OIL AND GAS BURNERS • STOKERS • PULVERIZERS • WASTE HEAT BOILERS
• FIRE AND WATER TUBE PACKAGE BOILERS • QUICK OPENING DOORS • PROCESS EQUIPMENT




| | |
|---|---|
| Capacity | 120,000 lbs./hr |
| Design Pressure | 675# |
| Operating Pressure | 600# |
| Steam Temperature | 750° F |
| Economizer | Erie City |
| Superheater | Erie City |
| Firing | Erie City "Travagrate" Stoker Inter-tube Gas Burners |




| | |
|---|---|
| Capacity | 150,000 lbs./hr |
| Design Pressure | 690# |
| Operating Pressure | 625# |
| Steam Temperature | 750° F |
| Economizer | Erie City |
| Superheater | Erie City |
| Firing | Erie City "Travagrate" Stoker |

For complete description of Erie City Spreader Stokers, dumping grate and continuous ash discharge types - - - Ask for Catalog SB-62.
You can depend on ERIE CITY for sound engineering

USED TO THINK EVERY STEAM TRAP LEAKED STEAM.
THEN I FOUND ONE THAT DIDN'T, BUT IT WOULDN'T VENT AIR.
FOUND ONE THAT VENTED AIR, BUT IT NEEDED A COOLING LEG.
DISCOVERED A TRAP THAT REMOVED CONDENSATE AT STEAM TEMP, -MAINTENANCE WAS TOO HIGH.
THEN I FOUND A LOW MAINTENANCE TRAP. IT DIDN'T WORK AGAINST BACK PRESSURE.
AT LAST I FOUND ONE THAT WORKED AGAINST BACK PRESSURE, BUT IT'S CAPACITY RATING WASN'T DEPENDABLE.
ARMSTRONG PROMISES TRUE CAPACITIES AND EVERYTHING ELSE, SO I CALLED THEM. THEY TOLD ME TO RELAX. I COULDN'T.
THEY TOLD ME ABOUT ARMSTRONG'S GUARANTEE. WHAT'D I HAVE TO LOSE, I TRIED THEM.
EFFICENCY IS UP, FUEL BILLS ARE DOWN, SO ARE MAINTENANCE COSTS. MAN I'M LIVING!

No one trap can do *everything* better than every other trap. Some traps vent air better than others, some remove condensate faster, etc. But, there is no one trap *best* in every phase of trapping. Armstrong has been manufacturing the Inverted Bucket Trap for nearly fifty years, and though the traps have changed with the requirements of the times, the Inverted Bucket principle has remained. For on overall trap performance, year-in and year-out, nothing beats the Armstrong Inverted Bucket Trap. It's a rugged well-built trap that does *more* things better than any other trap. It's guaranteed because it's been proved.

For more details, see your Armstrong Representative and start living . . .

*P. S. Like some good meaty reading? Ask for the 48-page Armstrong Steam Trap Book.*

**ARMSTRONG MACHINE WORKS**
**8123 MAPLE STREET**
**THREE RIVERS, MICHIGAN**

011-ST

*See Our Catalog in Sweet's Plant Engineering File*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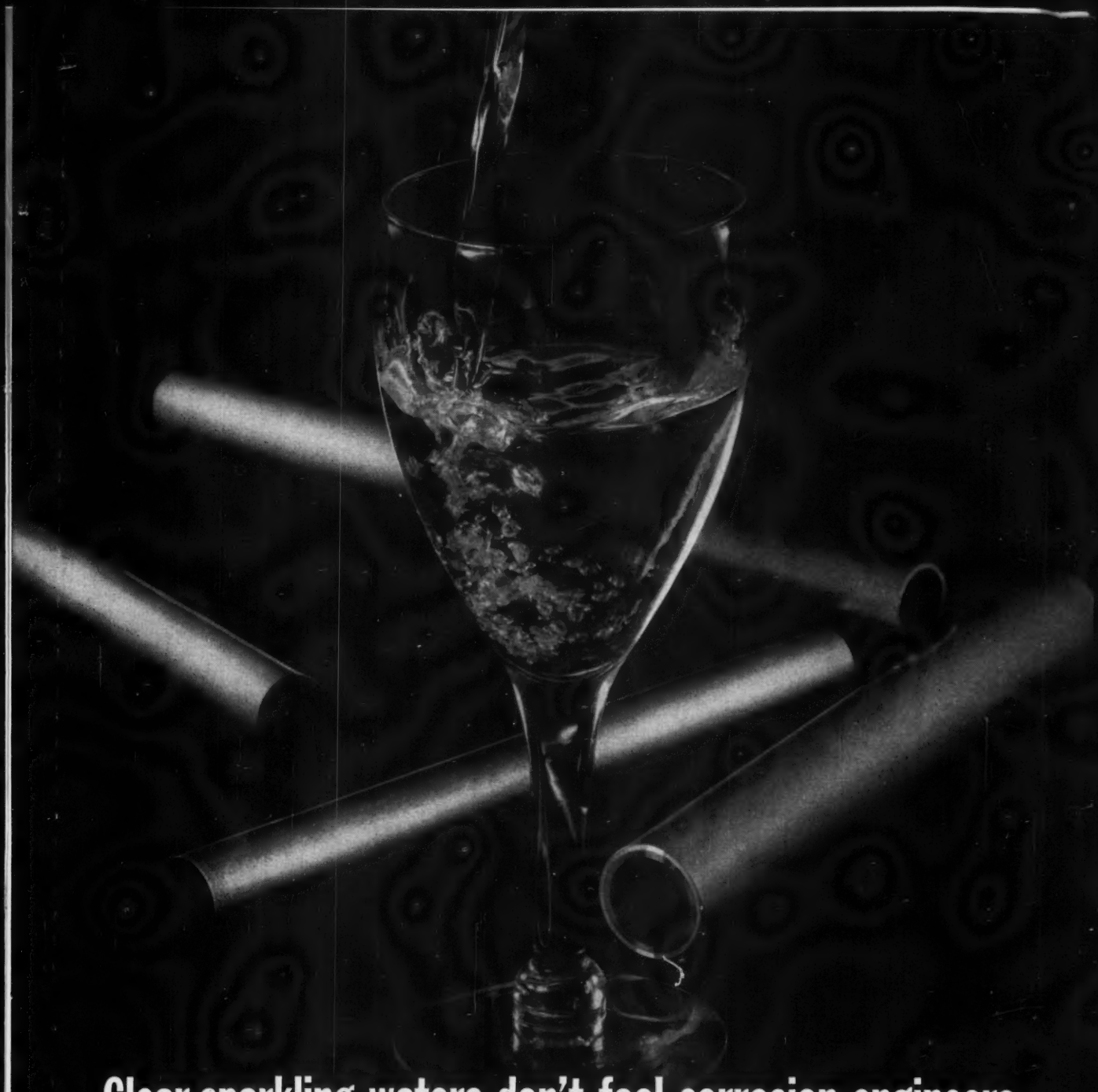

# Clear sparkling waters don't fool corrosion engineers

Coupled with temperature, pressure and velocity, some waters can chew up condenser tubes faster than you would believe possible. Minute differences in oxygen, chemical or biological content give each a corrosive character of its own that calls for well-informed tube alloy selection.

Case histories in which tube life has been increased from months to *years*—or from years to many *more* years—are packed in Bridgeport's files. The training and experience of our corrosion specialists can help match the best tube alloy to your water supply—whether potable, saline, brackish or polluted.

Write for information on Bridgeport's regular or Duplex tubes—or call in a Bridgeport man for quick and practical assistance on your corrosion, erosion or bio-fouling problems.

**Bridgeport condenser and heat exchanger tubes in over 50 metals and alloys:**

INHIBITED ADMIRALTY
INHIBITED ALUMINUM BRASS
INHIBITED MUNTZ METAL
70-30 CUPRO NICKEL
90-10 CUPRO NICKEL
DEOXIDIZED ARSENICAL COPPER
INHIBITED ALUMINUM BRONZE
RED BRASS
ALLOY 77 MERCURY BRASS

...plus **DUPLEX TUBES**...in combinations of the above alloys, with carbon or stainless steel, aluminum, Monel,® nickel...or other metals.

## BRIDGEPORT BRASS COMPANY

Bridgeport 2, Connecticut

Bridgeport

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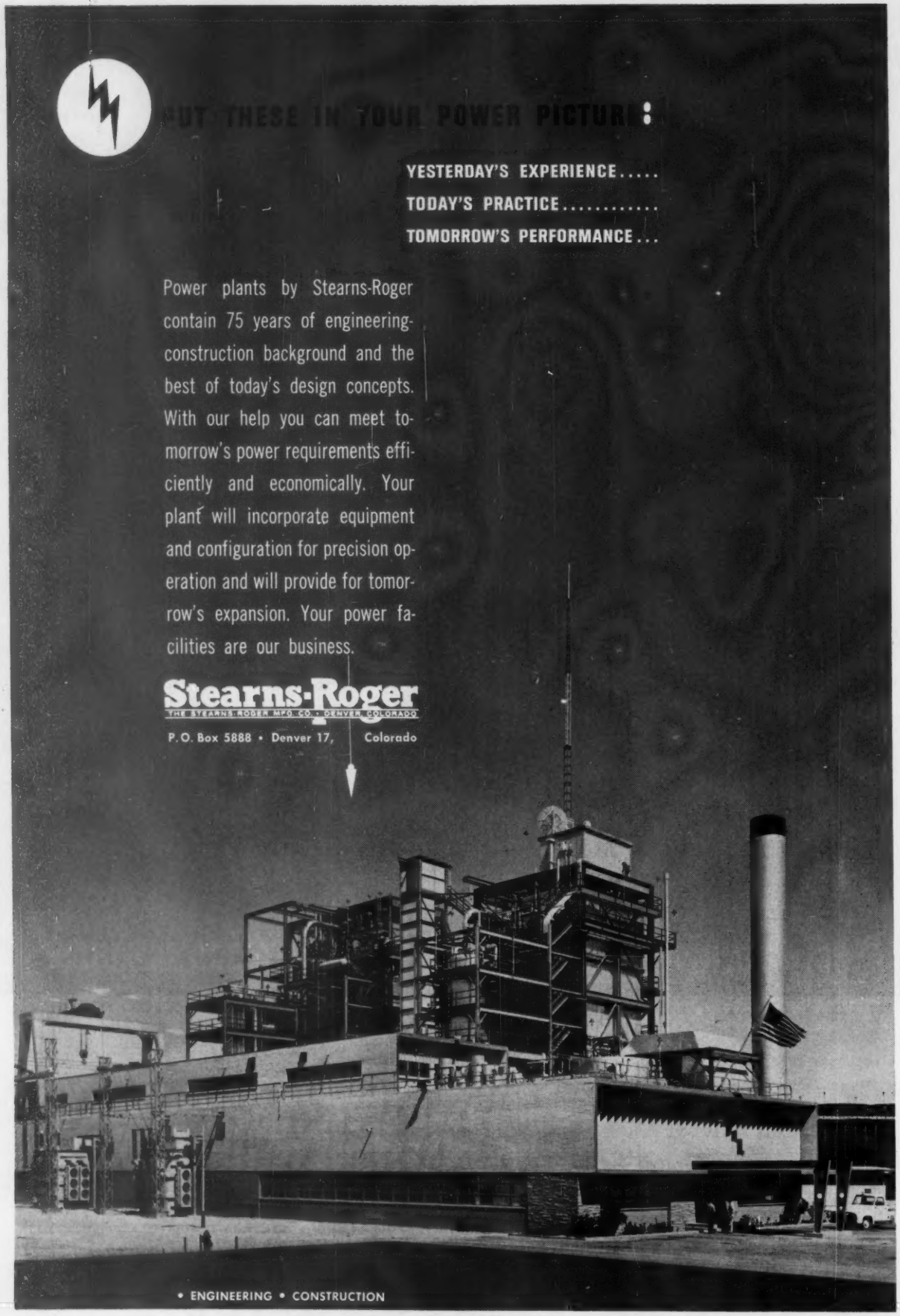
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YESTERDAY'S EXPERIENCE.....
TODAY'S PRACTICE.....
TOMORROW'S PERFORMANCE...
Power plants by Stearns-Roger contain 75 years of engineering-construction background and the best of today's design concepts. With our help you can meet tomorrow's power requirements efficiently and economically. Your plant will incorporate equipment and configuration for precision operation and will provide for tomorrow's expansion. Your power facilities are our business.
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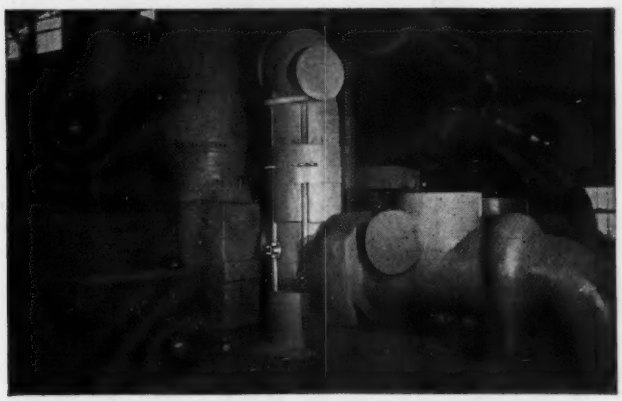
P.O. Box 5888 • Denver 17, Colorado
• ENGINEERING • CONSTRUCTION

One of four Zallea-developed toroidal, pressure-balanced expansion joints at Philadelphia Electric's Eddystone station. Anchored at reheat stop valve, expansion joint absorbs movement at flow end bellows (top). Expansion joints are 20″ I.D., operate at 290 psi, were tested at 580 psig. The unit is cut-away to show internal construction.



This is one of the four Zallea HyPTor expansion joints on-line, protecting piping and turbine casing.

# ZALLEA HYPTOR* EXPANSION JOINTS

## offer maximum reliability for Eddystone's superpressure turbine

Philadelphia Electric's new Westinghouse superpressure turbine generating unit whirls out 325,000 kw of electric power at unprecedented pressures and temperatures of 5000 psi and 1200°F. Such performance requires uncommon protection to minimize thermal stresses in the turbine casings. Four Zallea HyPTor* expansion joints do these vital jobs of safe-guarding the intermediate pressure element from effects of thermal expansion created by cyclic operation to 1050°F at 290 psi.

An exclusive Zallea design, the universal toroidal, pressure-balanced expansion joint absorbs both axial and lateral expansion. Each expansion joint has a set of three bellows, two at the flow end, one at the balancing end. Toroidal corrugations are hydraulically formed, proved the most reliable construction for such applications.

Zallea's HyPTor* expansion joints were selected for tested, total effectiveness under extreme pressures and elevated temperatures. Comprehensive engineering data on expansion joints from 3 inches to 50 feet in diameter, to pressures of 3600 psi, temperatures to 1600°F will be found in catalog 56 . . . write today.

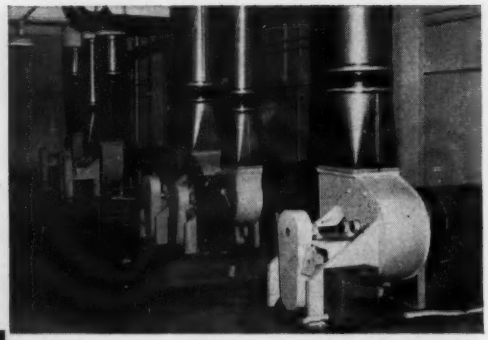
*Patented

Zallea

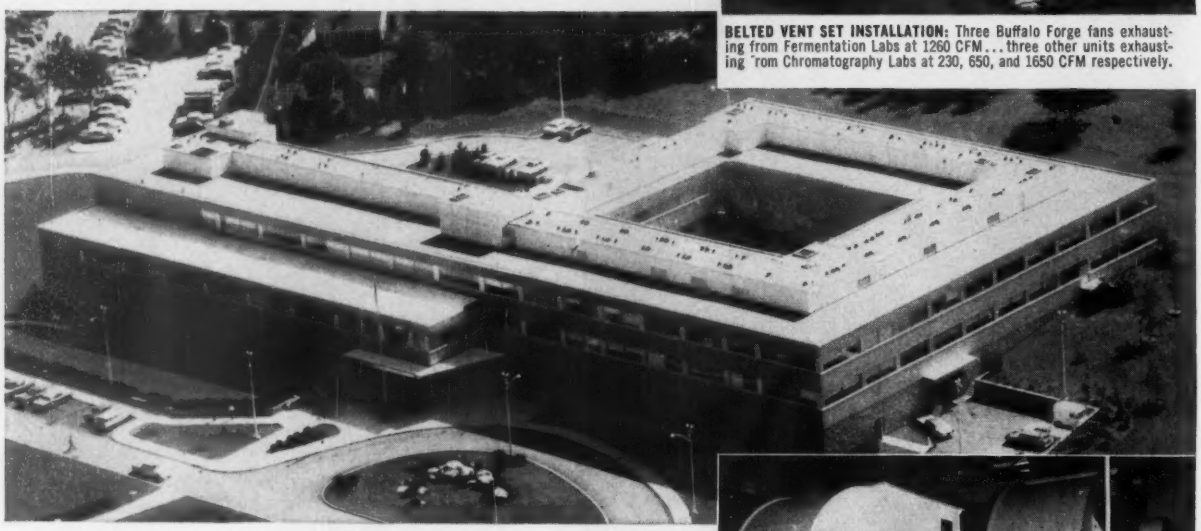
**FOR MAXIMUM RELIABILITY**

**WORLD'S LARGEST MANUFACTURER OF EXPANSION JOINTS**

# HEALTHY 'BUFFALO' ATMOSPHERES HELP ...PFIZER'S FIGHT



**BELTED VENT SET INSTALLATION:** Three Buffalo Forge fans exhausting from Fermentation Labs at 1260 CFM... three other units exhausting from Chromatography Labs at 230, 650, and 1650 CFM respectively.



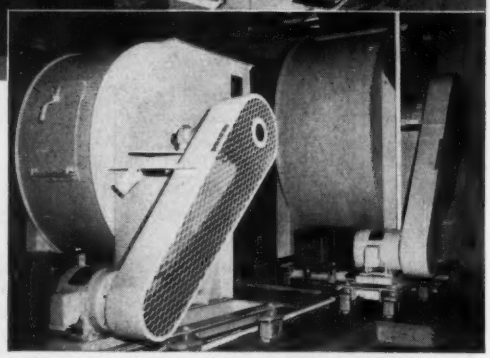
New Medical Research Laboratories of Chas. Pfizer and Co., Inc. at Groton, Connecticut, a modern three-story facility staffed by more than 400 scientists, technicians and supporting personnel engaged in such specialized fields as medicinal chemistry, chemotherapy, macrobiology and fermentation research. Air conditioned and ventilated throughout with Buffalo Forge equipment.

In the world of medicine, purity of ambient air is vitally important to purity of product...and the health of research workers.

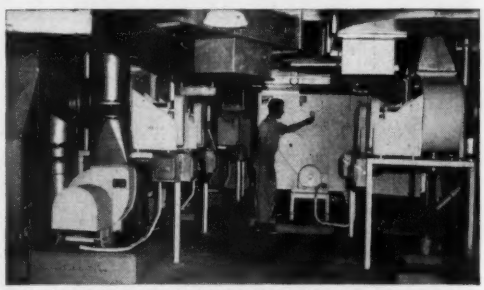
That means that impure and contaminated atmospheres must be exhausted and replaced by clean, tempered air ... continually, dependably, and at installation and maintenance costs that contribute to maximum research capability.

Complete air conditioning systems and supply and exhaust fans by Buffalo Forge fill these requirements not only at Pfizer, but in countless commercial, industrial, and marine applications around the world.

A call to your resident Buffalo Forge representative ... or the address below... will place sound engineering recommendations at your disposal. Plus the widest range of air and liquid handling equipment in the industry.



**TYPE BL FANS:** Buffalo Forge Class #1 unit (L) exhausting several rest rooms at 4725 CFM... another Class #1 exhausting office areas and non-chemical labs at 9700 CFM.



**AIR MAKE-UP SYSTEM AND EXHAUST SYSTEMS:** Buffalo Forge Type PC unit (center rear) distributing 50° tempered air to six labs at 10,800 CFM... seven Belted Vent Sets exhausting from laboratory hoods at 2900, and 1500 CFM.

AIR HANDLING DIVISION

**BUFFALO FORGE COMPANY**

Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

*'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.*

*'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.*

*'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.*

*Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.*



For more facts circle 795 on Reader Service card, p 197

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PFI is a group of companies specializing in pipe fabrication who contribute funds and experienced manpower to research and to correlate facts and technical advancements for the purpose of improving pipe fabricating techniques.

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1 Machining Backing Rings for Butt Welds
2 Dimensioning Welded Assemblies
3 Linear Tolerances Bending Radii
4 Shop Hydrostatic Testing
5 Cleaning Fabricated Piping
6 Built-up Weld, Metal Bosses
7 Welded Nozzles — Spacing
8 Preheat - Postheat Welding, Low Chrome — Moly Pipe
9 Arc-Welding Dissimilar Ferritic Steels
10 Stress Relieving Practices
11 Affixing Permanent Symbols to Piping
12 Preheat - Postheat Welding, Medium Low Chrome — Moly Pipe
13 Classification, Shop Testing, Inspection, Cleaning




For more facts circle 796 on Reader Service card, p 197

# All-hydraulic speed governing for steam turbines

*By N. K. Halsteen, Project Engineer, Brown Boveri Corp.*

BROWN BOVERI

*Brown Boveri was first to develop and use hydraulic speed governing . . . with patents as early as 1906. The all-hydraulic system eliminates rods, levers and mechanical linkages which, through thermal expansion, wear and excess play, interfere with reliable, sensitive speed control.*

*The hydraulic system also allows design refinements involving hydraulic relays and servomotors for amplification of control impulses . . . without any mechanical linkage.*

*Modifications have adapted the governing system to modern reheat units of all sizes.*

## Description of system

Fig. 1 shows the Brown Boveri governing system for units without reheat.

The main oil pump supplies oil at approximately 70 psi to bearings and as an operating medium, to the power pistons of the nozzle valves. At reduced pressure it also supplies oil to the emergency and governing oil systems. At start-up, the emergency oil system is actuated first and opens the main stop valve. Then the nozzle valves open in sequence via the governing oil system and relay pistons.

If shaft speed is increased by a reduction of load, the spring-loaded centrifugal speed governor opens a port that reduces pressure in the governing oil system and thus closes the nozzle valves. (This port is also controlled manually or remotely for paralleling units or altering load distribution.)

Operated by a single handwheel, the starting gear controls both the emergency and governing oil systems and thereby the valve positions. At the preset limit for overspeed, the overspeed governor causes the starting gear to rotate instantly to shut-down position, depressurizing the oil systems.

Nozzle valves are double seated for balanced operation at relatively low oil pressures. Relay springs are of stepped tensions – to open valves in preset sequence.

The overspeed test screw (not shown) introduces oil under pressure to replace centrifugal force – allowing tests of overspeed governor and shut-down system at normal speed. Other valves test the main stop valve and nozzle inlet valves (at no load).

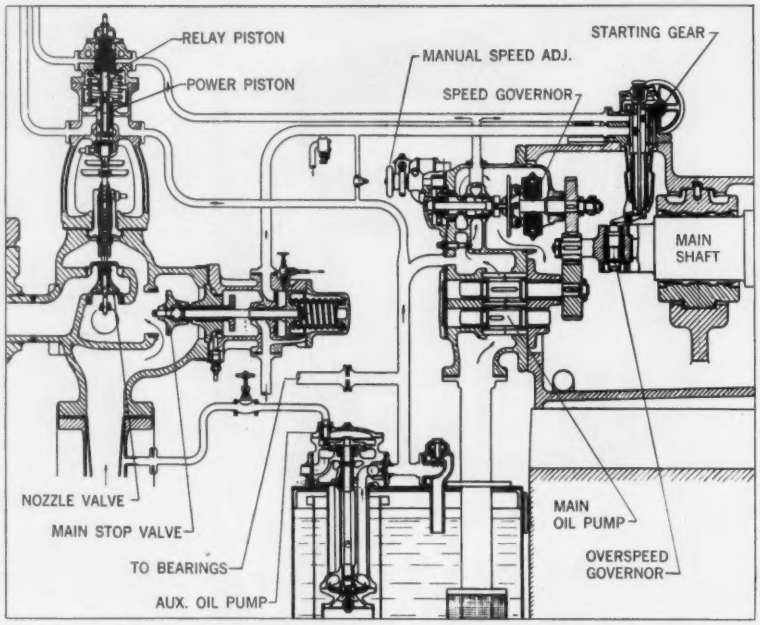



Fig. 1 Linkage-free pressure oil governing system with relay-operated nozzle valves.

## Modifications for large reheat turbines

To eliminate the fire hazard introduced by very high steam temperature, non-combustible fluid is used in place of oil for the speed-governing system. Oil, with separate tank and pumps, is used for lubrication only.

A pressure-gradient relay controls the interceptor valves between reheater and ipt turbine – to avoid undesirable temporary speed deviations at sudden load change. Fig. 2.

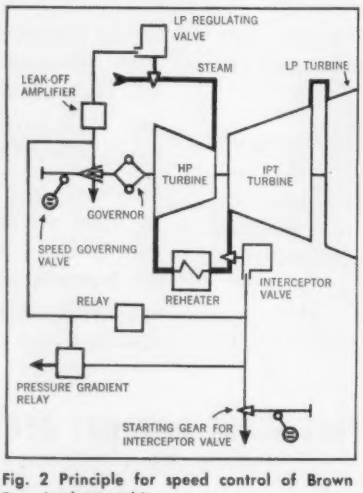



Fig. 2 Principle for speed control of Brown Boveri reheat turbines.

Single-seat nozzle valves are used with high pressure valve control fluid (approx. 400 psi.)

When governing oil pressure drops rapidly, the leak-off amplifier opens a drain port in the valve control oil line . . . shortening closing time for the nozzle valves.

## Advantages of Brown Boveri speed-control system

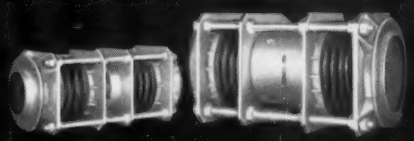
Highly sensitive speed control without "hunting." No mechanical play. Short, compact piping. Almost negligible wear since valve pistons and other critical parts operate in oil.

Positive bearing protection with oil pump driven by turbine shaft. No booster pump required. Double overspeed protection with two overspeed governors on larger units and simple testing of shut-down systems.

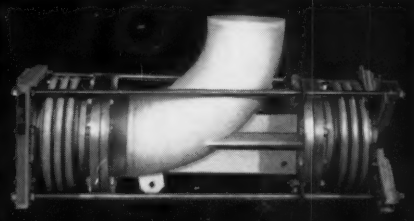
No governing-oil fire hazard. No expensive double-guard pipe and fittings for governing fluid.

Minimum throttling losses and symmetrical heating through advanced nozzle design and control.

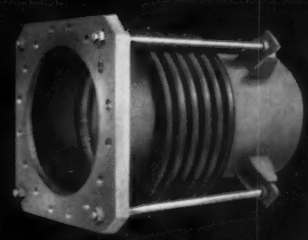
**BROWN BOVERI** Brown Boveri Corp., Dept. P10, 19 Rector Street, New York 6, N. Y. Agents in 27 U. S. cities



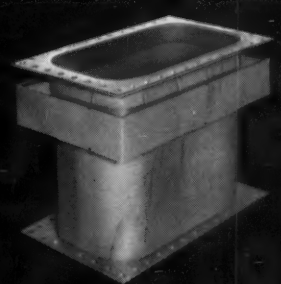
This pair of universal expansion joints is installed in the vapor piping of a gaseous diffusion plant. The lines carry Freon 114 at pressures up to 500 psig and temperatures ranging from −20°F to 300°F. Joints accommodate 3" lateral movement under these extremely harsh service conditions.



A 12" pressure balanced elbow assembly specially engineered by Badger for use in LOX storage and transfer facilities at an Air Force Missile Base. The unit is designed to operate at temperatures from −297°F to 250°F — a thermal shock range of nearly 550°! Operating pressures vary from 0 to 150 psig. Joint movement: 0.8" axial, 0.15° lateral.



One of eight specially engineered Badger Expansion Joints at a power plant for a gas recovery unit in Texas. Installation is on a cooling water piping of the surface condensers where service conditions require operation at 55 psig at a temperature of 107°F. The joints are designed to absorb ½" lateral movement in combination with ¼" axial movement.



This 24" x 44½" I.D. rectangular expansion joint, connects the turbine and condenser at a steam power plant. Each of the units is designed to operate at a pressure ranging from full vacuum to 1 psig at a temperature of 360°F. The joint handles ⅜" axial compression and a plus or minus ¼" lateral movement.

# TOUGH JOINTS

## — BADGER SPECIALTY

Anyone with the necessary manufacturing facilities can fabricate expansion joints. But it takes an *experienced* manufacturer to analyze tough piping problems properly and then provide the correct expansion joints to solve them. Badger, with more than 55 years in the field, has had more experience with a wider variety of special design problems than any other expansion joint manufacturer. Put this store of skill and knowledge to work for you — get the most effective and economical solution to your expansion joint problem. Call or write for complete information about Badger S-R Expansion Joints and our "on-the-spot" engineering service.

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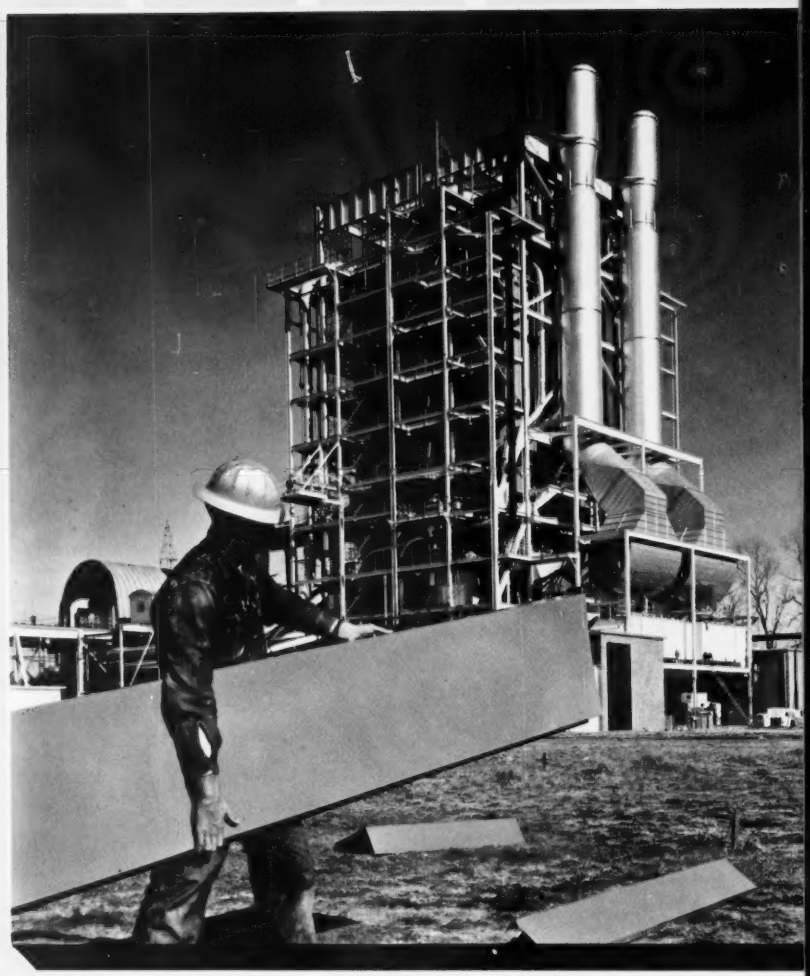
# AVONCRAFT PORCELAIN-ON-STEEL LAGGING

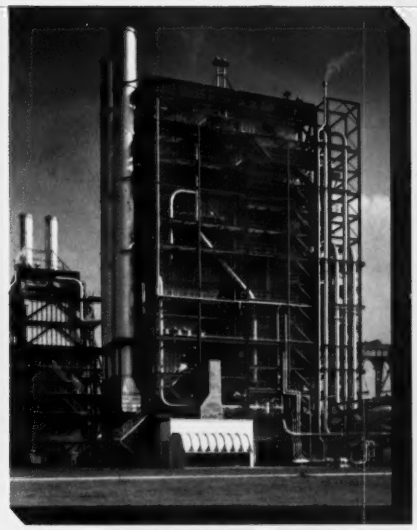


## *now protecting 4 POWER STATION BOILERS*

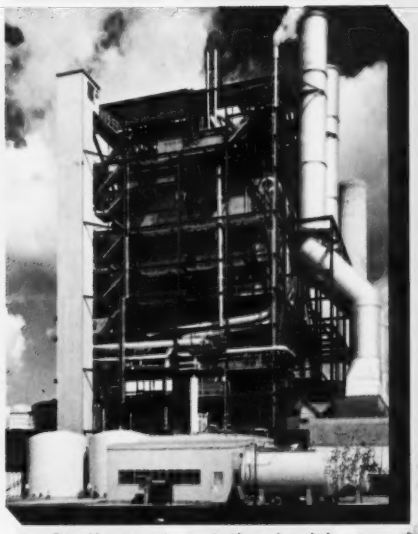
With the completion of the Louisiana Power & Light Company Little Gypsy steam-electric generating station in St. Charles Parish, La. ***200,000 square feet of colorful, durable, weather-resistant Avoncraft porcelain-on-steel lagging is now in service, protecting millions of dollars of valuable boilers and uptakes.***

We at Avoncraft are particularly proud to serve this important construction requirement of the vital, growing power generating industry, and are most grateful to the construction engineers for their research and acceptance of our product.

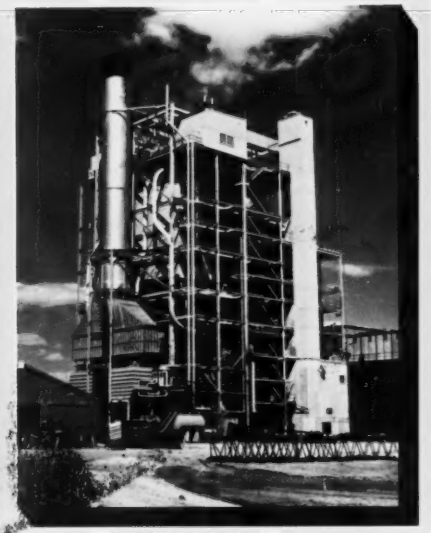
Avoncraft is prepared to engineer, fabricate and erect porcelain enamel lagging on boilers anywhere—domestic or foreign. We invite your inquiries.



Louisiana Power & Light Company steam-electric generating plant at Nine Mile Point, La. Approximately 50,000 sq. ft. of Avoncraft lagging.



Sterlington, La., station, Louisiana Power & Light Company. Close to 45,000 sq. ft. Avoncraft porcelain-on-steel lagging protects its boilers.



The Gordon Evans Station Steam Generating Plant, Kansas Gas & Electric Company, Colwich, Kan. Approximately 43,000 square feet of lagging on boilers and elevator shafts.

"Porcelain City"—Louisiana Power & Light Company Little Gypsy steam-electric generating station, St. Charles Parish, La. Approximately 62,000 sq. ft. of lagging on boilers, shafts. Also of Avoncraft porcelain-on-steel are: water treatment plant, sub-station house, switchyard, relay house, maintenance operator's laboratory, two fan houses, warehouse, storekeeper's office and eleven fire hose houses.

*Ebasco, Inc., consulting engineers and designers.*

Avoncraft architectural porcelain-on-steel is weatherproof, corrosion proof, completely eliminates painting. It is colorful, (any color required) easy to clean with soap and water. Panels engineered, fabricated, porcelainized and erected by Avoncraft—"turnkey" service that saves time and money.

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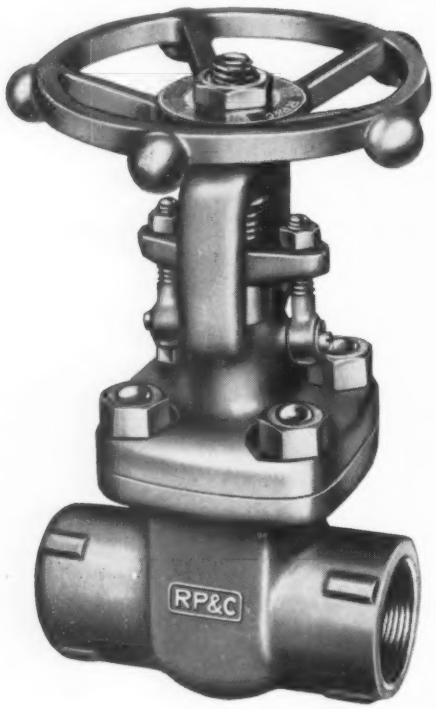


R-P&C has re-engineered its Forged Steel Valve line to meet the highest standards of quality for the Refinery, Chemical, Power and Process industries. These valves incorporate the most up-to-date design and material improvements found in any forged steel valve! One example is the stuffing box—redesigned for 50% greater sealing efficiency. These improvements add up to longer, trouble-free valve service for you, with minimum maintenance.

Here are other R-P&C Forged Steel Valve improvements:

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- **"390 Brinell" stem with rolled threads for continuously smooth movement**
- **Moly-Disulphide lubricated oil grooves in operating nut give easiest operation**
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- **Thrust washer between handwheel and operating nut eliminates seizing and galling**

In addition to Forged Steel Gate and/or Globe Valves, R-P&C distributors offer users in all industries a complete line of R-P&C gate, globe and angle valves in all standard materials: iron, bronze, bar stock, cast steel—plus many specialties.

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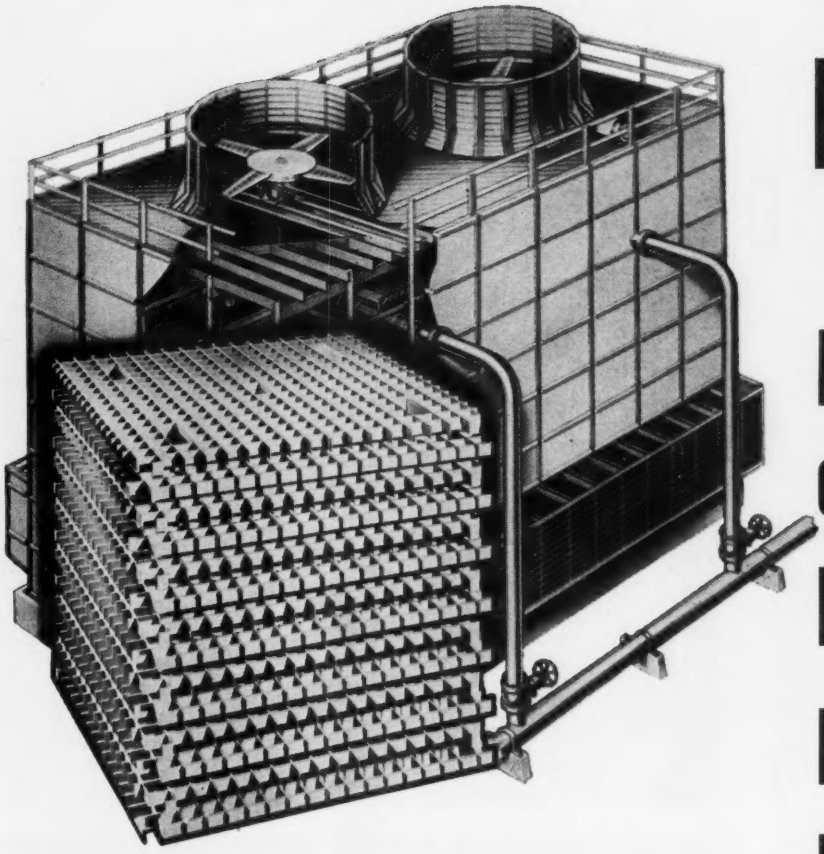

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# He's gunning B&W KAOCRETE-D ...the refractory castable that withstands punishing ashpit service

Relining ashpits in stoker-fired or pulverized-coal-fired boilers is expensive and time-consuming. To reduce maintenance in this severe service, B&W has developed durable Kaocrete-D, a refractory castable which can be wet or dry-gunned into place — or cast using modern materials handling methods. It withstands the punishing effects of abrasion, erosion and spalling in virtually every ashpit design.

Widely used in all types of boiler ashpit hoppers and slag tanks, Kaocrete-D has proved its economy and durability. Where abrasive and erosive conditions are less severe, B&W Kaocrete-A will give satisfactory service.

Cut the frequency of maintenance and expensive relining jobs by using heavy-duty B&W Refractory Castables. Send for Bulletin R-40 which gives data on B&W Kaocrete Refractory Castables for lining ashpits. Write to: The Babcock & Wilcox Co., Refractories Division, 161 East 42nd Street, New York 17, N. Y.

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REFRACTORIES DIVISION

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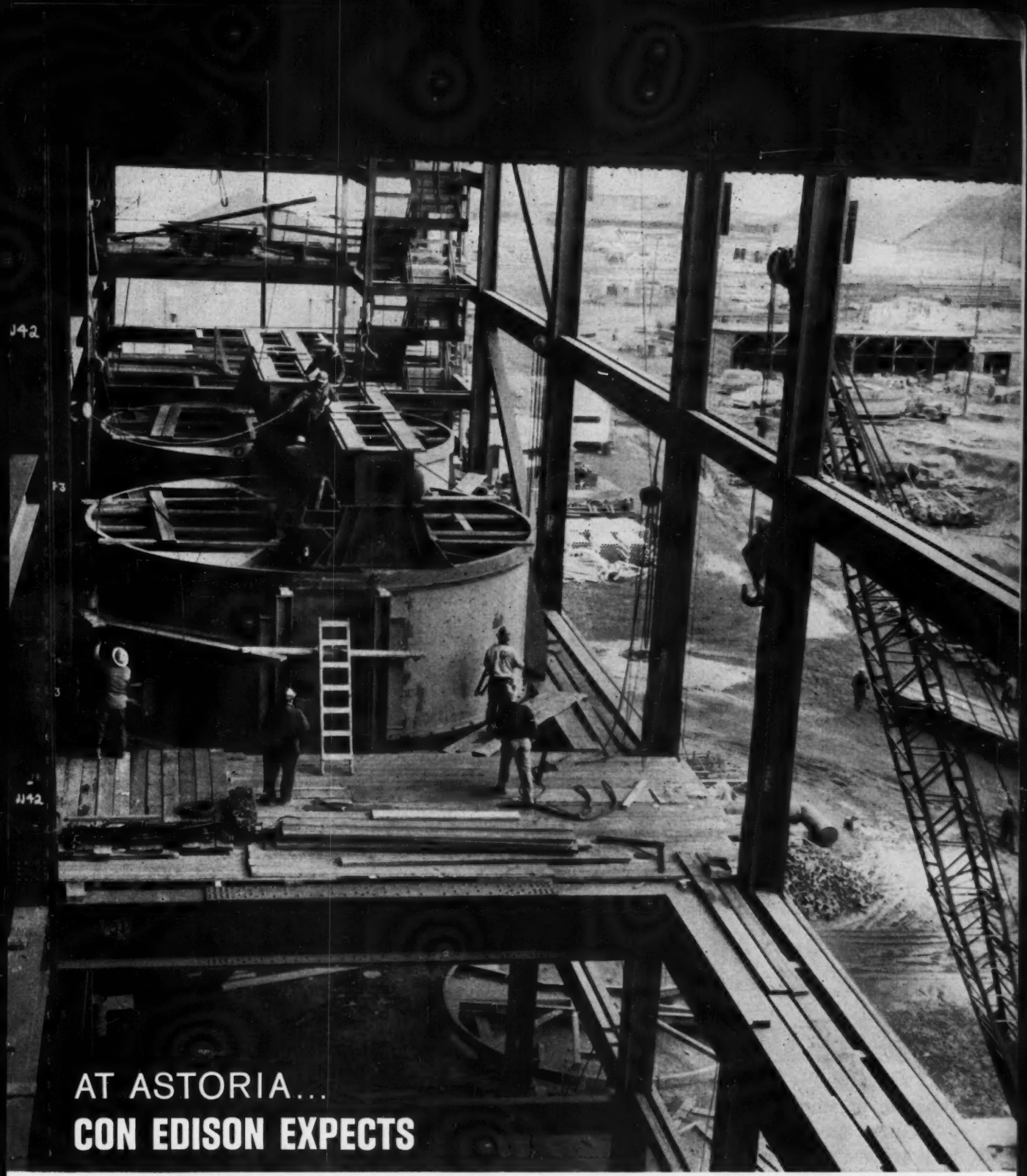

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Four new Ljungstrom Air Preheaters are being installed by Consolidated Edison Company of New York, Inc., on their Astoria Stations' #50 boiler unit. With a total heating surface of about 547,000 sq. ft., these four units are designed to reduce the stack temperature 345° F. By transferring this heat to the incoming combustion air, a fuel savings of about 8% is realized. Addition of these units makes a total of 16 Ljungstroms installed at Astoria . . . 77 either installed or on order in the entire Con Edison system.

Our engineers will be glad to recommend ways to improve your operating results on new or existing fuel fired units. For information, please write to:

**THE AIR PREHEATER CORPORATION**

*60 East 42nd Street, New York 17, N.Y.*

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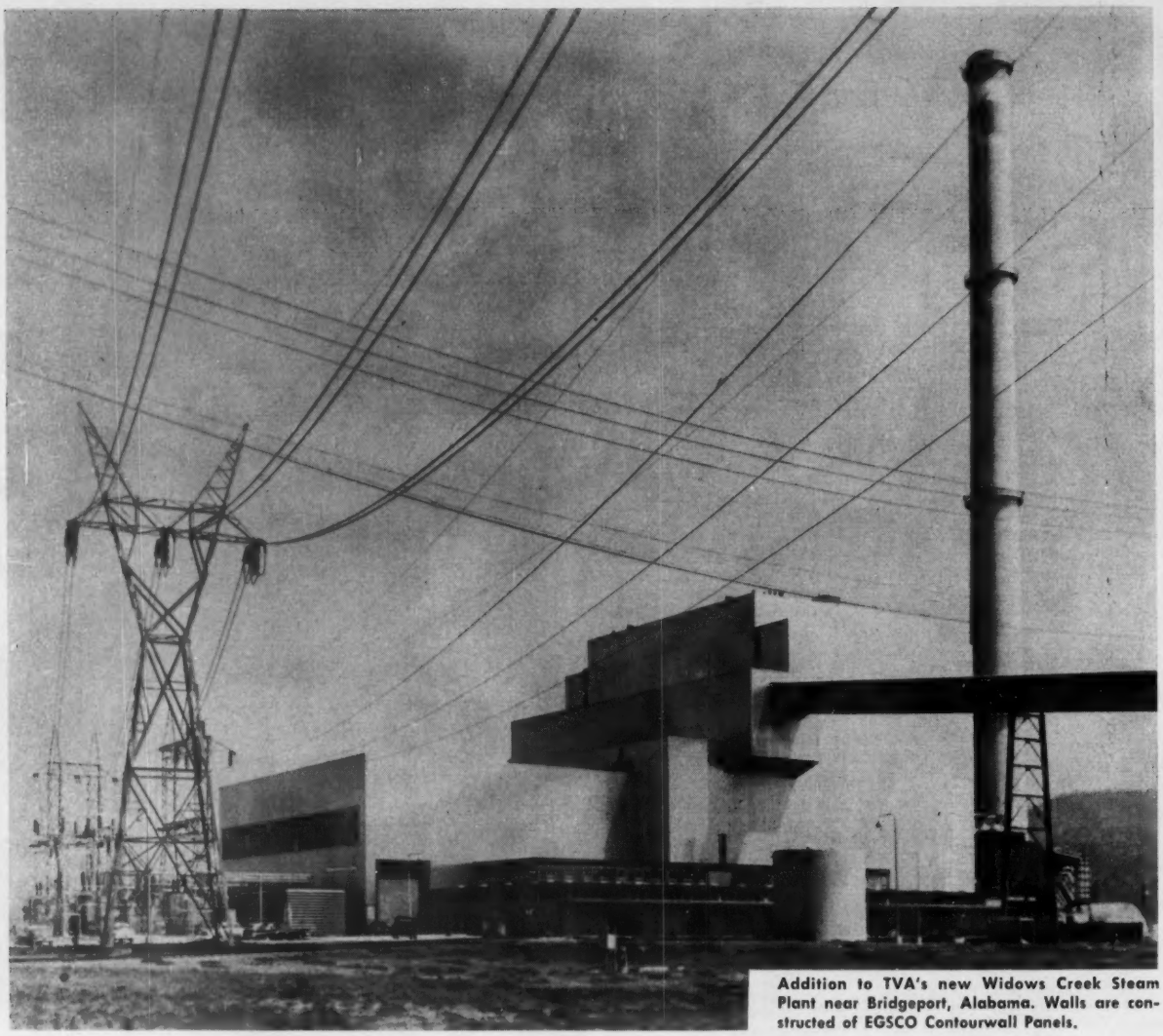

Addition to TVA's new Widows Creek Steam Plant near Bridgeport, Alabama. Walls are constructed of EGSCO Contourwall Panels.

*When you're faced with a huge power plant cover problem—*

## look to the economy of EGSCO® insulated metal walls!

Large wall areas go up quickly and securely by the EGSCO method of wall construction that substantially cuts erection man-hours. Whether of aluminum, aluminized steel, or galvanized steel, you get a sound, durable wall with ample insulation and baked-on protective enamel with your choice of architectural color.

The structural strength of EGSCO Wall Panels reduces your steel framing costs, too, because their allowable longer span reduces the necessary number of steel girts.

For complete information and specifications for EGSCO Wall Panels, write for Bulletin 62W.

Also available to architects and engineers is the new Catalog of Standard Details, from which scale prints may be selected and requested as needed to assist in construction plans and engineering specifications.

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Typical Coppus Blue Ribbon features are: *totally enclosed governor . . . totally enclosed and independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.* You get higher efficiency operation . . . less down time . . . lower maintenance costs.

Coppus Turbines are built to customers' specifications, including API and NEMA standards. Send for Catalog 200. Get complete details on Coppus Turbines. Sizes from 1 HP to 250 HP. Write COPPUS ENGINEERING CORPORATION, 170 Park Avenue, Worcester, Mass. Sales Offices in *Thomas' Register*.

**COPPUS**
**STEAM TURBINES**

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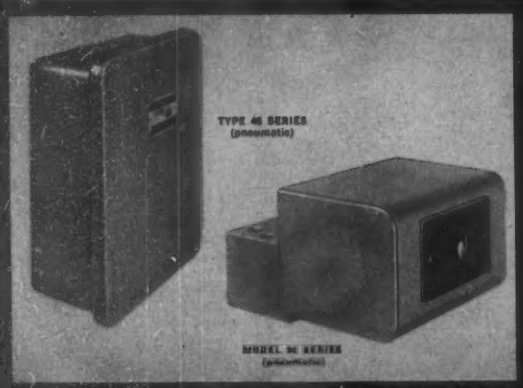
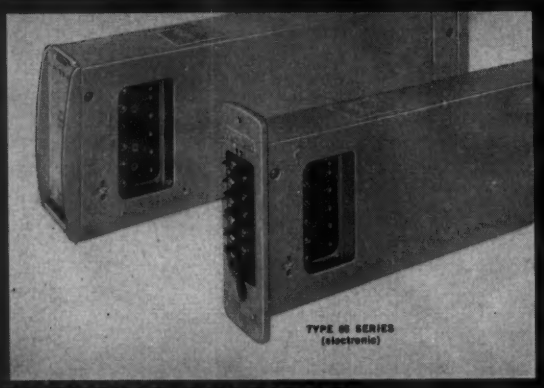
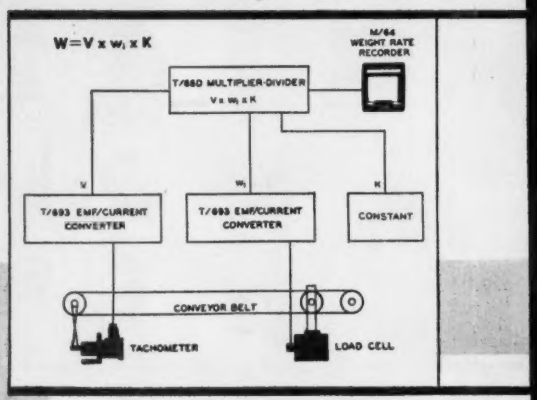
# new low-cost Foxboro automation of power



## FOXBORO ANALOG COMPUTING STATIONS

▶ TYPICAL




**WEIGHT RATE COMPUTATION**

Gives operator continuous recording of actual weight of solid fuels being conveyed by belt. For example, T/66D Multiplier-Divider calculates actual weight-rate from load cell and belt speed measurements.

For more facts circle 806 on Reader Service card, p 197

# Analog Systems simplify plant computations

## both pneumatic and electronic units available

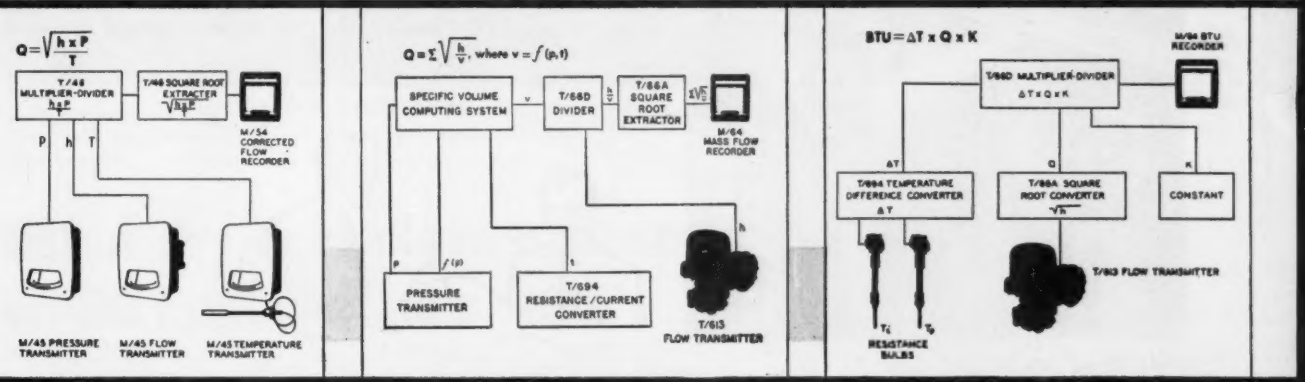
**Analog computing systems** have been known and used for years. Yet their potential for increasing plant efficiency has hardly been scratched.

Just look what they can do! Continuous calculation of all the arithmetic functions: addition, subtraction, multiplication, division, square root extraction — in any combination. And all done automatically by a single packaged system.

And look how it simplifies the operator's job. Instantaneous calculation . . . with records to prove it. No slide rules, no interpolation, no planimeters — and most important — no mistakes.

Because Foxboro Analog Computer Systems are relatively low-cost ($2500-5000 average) you can "spot" them about your plant for maximum efficiency. Or, they can be grouped together at a central location to solve more complicated equations. Pneumatic and electronic systems available.

**CALCULATIONS MADE WITH FOXBORO ANALOG COMPUTING SYSTEMS**




### GAS FLOW COMPUTATION

In common use to compensate gas flow readings — air and fuel — for changes in line temperature and/or static pressure. In the pneumatic system shown here, the Foxboro T/46 Multiplier-Divider and the Square Root Extractor allow operator to read corrected flow directly.

### MASS STEAM FLOW COMPUTATION

Calculates weight-rate of superheated steam flow, through a specific volume computing system individually designed for each application. Pressure, temperature, and flow measurements are combined so operator can read mass steam flow directly on a M/64 Recorder.

### BTU COMPUTATION

Determines actual amount of heat being transfered to or from a heat exchanger. Electronic system shown uses a Foxboro T/66D Multiplier-Divider to produce a signal equal to product of flow and temperature difference. Operator reads directly in Btu's.

WHAT CALCULATIONS WOULD YOU LIKE TO AUTOMATE? ➔

FOXBORO
REG. U. S. PAT. OFF.

**The Foxboro Company, 5810 Neponset Ave.**
**Foxboro, Mass.**

I have a plant computation I should like to automate. Can a Foxboro Analog Computing System do it for me?

**I want to compute**.....

.....

**Name**.....

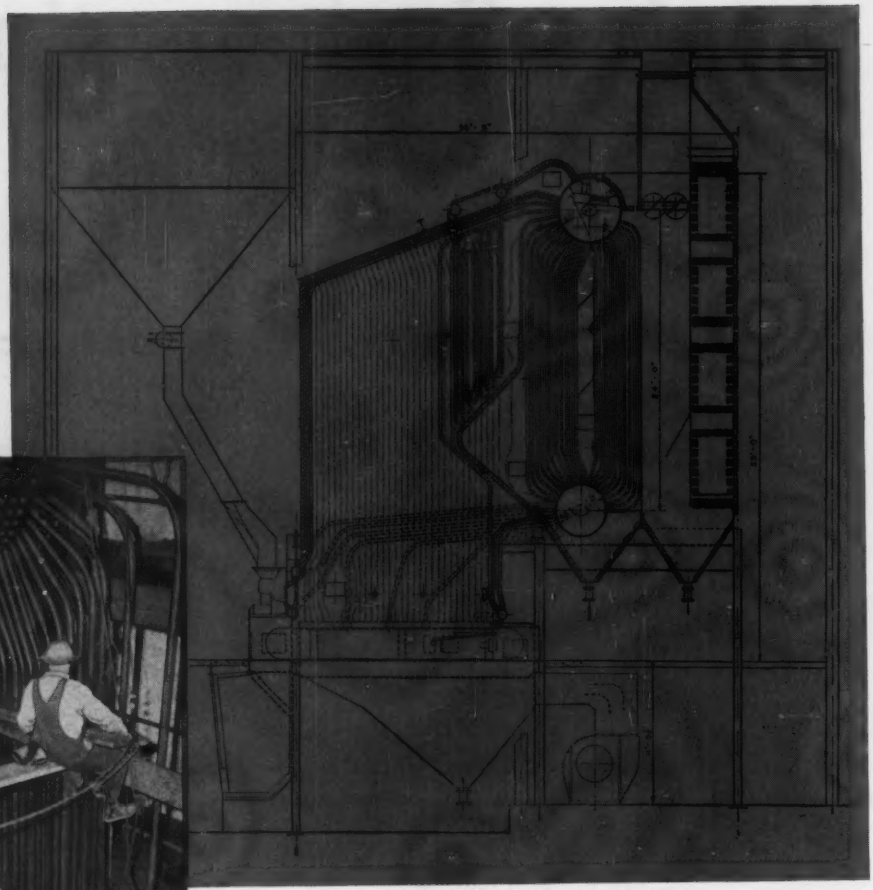
**Position**.....

**Company**.....

**Address**.....

**City**.....**State**.....

# Union Starch Installs a Modern Coal Fired Steam Generator



*Longitudinal section through unit.*

*Tubes being installed in steam and water drums.*

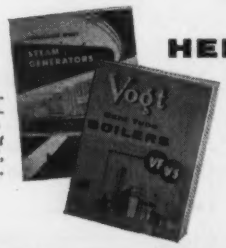
PROJECT BY
ROGERS SCHMIDT
ENGINEERING CO.
ST. LOUIS, MO.

This 125,000 pounds per hour capacity Vogt Steam Generator, especially designed to burn bituminous coal, serves the Granite City, Illinois plant of the Union Starch and Refining Company. The unit operates at 475 lbs. pressure and delivers steam at 750°F. total temperature. It has water cooled front, sides and roof of furnace and employs a spreader type coal stoker.

Vogt offers a complete line of custom built and package type steam generators for power, processing and heating. Bulletins are available upon request.

Vogt

*For Custom Installation Bulletin VF-VS-2 • Package Unit Bulletin PSG-3, address Dept. 24A-BP.*




**HENRY VOGT MACHINE CO.**
**P.O. BOX 1918, LOUISVILLE 1, KENTUCKY**
**SALES OFFICES:** New York, Chicago, Cleveland, Dallas, Camden, N. J., Los Angeles, St. Louis, Charleston, W. Va.

*For Direct Long Distance to Louisville Dial: 502 ME 4-9411*

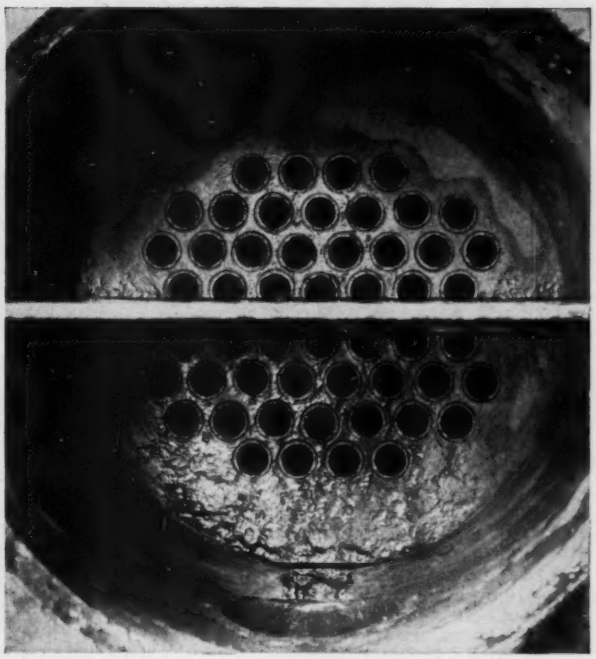
**STEAM GENERATORS**



For more facts circle 807 on Reader Service card, p 197

# Descale equipment quickly, safely, —without dismantling!

**BEFORE**—This condenser was badly clogged with hard-water scale. Mechanical cleaning of the tubes would have been difficult, time-consuming and costly. To use hydrochloric acid would pose danger to nearby equipment and personnel.



**AFTER**—It was easily cleaned *without dismantling* by circulating a water solution of a sulfamic acid-based cleaner for an hour. Short downtime, *no* danger to equipment and complete safety for personnel!

## Use a dry-acid cleaner based on Du Pont Sulfamic Acid

**They're effective.** Dry-acid cleaners dissolve most water-side deposits found in condensers, boilers, compressor jackets, heat exchangers, etc. Yet they're much less corrosive to metal than hydrochloric-acid cleaners.

**They're easy, safe.** Just dissolve the solid cleaner in water and circulate through the equipment. No danger of broken carboys, spilled liquids or toxic fumes—glasses and gloves are the only protective clothing needed!

**They're economical, fast.** 1 lb. of dry cleaner does the job of 1.3 lb. of 28% hydrochloric acid—you save on shipping, handling, storage and downtime (because there's no dismantling).

Horizontal and vertical condensers, stills, compressors, etc., are readily and economically descaled in place with cleaners based on Du Pont Sulfamic Acid. Plant personnel do the job with a minimum of equipment.

Ask your water-treatment company's technical representative about dry-acid cleaners; chances are, he can supply you. Or send the coupon for booklet and names of formulators offering dry-acid cleaners based on Du Pont Sulfamic Acid.

DU PONT
REG. U. S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

E. I. du Pont de Nemours & Co. (Inc.)
Industrial and Biochemicals Department, N-2545P,
Wilmington 98, Delaware.

Please send your "Descale" booklet and names of formulators offering cleaners based on sulfamic acid.

*Name*_____

*Company*_____

*Address*_____

*City*_____ *State*_____

ONE OF A SERIES OF CHATS ABOUT CONSERVATION AND CONTROL OF HEAT

# SARCO TOPICS

## SO YOU THINK YOU'VE GOT TEMPERATURE CONTROL PROBLEMS

When plant men get together and talk about their temperature control problems, strong men may weep. It's so darned basic—that narrow range of degrees which must be maintained—so closely allied to profit and loss. Let us tell you about one situation that may even top yours, and may clue you in on a good solution. It concerns wine, of all things.

Take those basic temperatures. Wine must be pasteurized at 140°F. Those are the facts of life in the world of wine. They might not seem too difficult to live with unless you are concerned with heat. Then you probably know how tough things can get when you have a rendezvous with a thermometer.

Take New York's Monarch Wine Company, producers of Manischewitz Wines. Their Problem: how to maintain the 140° temperature in the heat exchangers despite wide variations in the rate of wine flow. These variations, between 5 to 60 gallons per minute, result from slowdowns and recoveries in the bottling process. Problem: entire system must be capable of complete shutdown when necessary. Problem: wine temperatures must be raised to 140° as rapidly as possible, sometimes an immediate jump of 100°.

Attracted perhaps by aspects of the situation that had little to do with pure science, Sarco engineers applied the collective experience of Sarco technology to the solution of this serious problem. The result for Monarch: the *degree of control* the process demanded—achieved through the excellent use of Sarco Temperature-Pressure Regulators, Float Thermostatic Steam Traps Thermo-Dynamic Steam Traps, and Pipeline Strainers.

Sarco engineers, ever resourceful, divided each of the two large Cherry-Burrell plate-type heat exchanger units into two separate

sections with a blank baffle plate, each with a separate Sarco control. Thermal sensing bulbs were installed in wine discharge and throttling controls hooked into steam supply. As demand fluctuates, one or both regulators function to maintain the 140° temperature. In higher demand, both regulators are operative; as demand drops and flow decreases, only one regulator supplies steam. Pasteur himself would have been elated.

Each of six smaller capacity shell-and-tube heat exchangers required only one regulator, with the sensing bulb inserted into the outlet side of the wine filled shell, and the regulator throttling steam supply to the tube section. Thus, by controlling flow of steam to the exchangers on the basis of pressure and temperature, the Sarco regulators were able to maintain the temperature of the wine at precisely 140° regardless of fluctuations in demand or supply rate. Whew! A lot of engineering went into those two sentences.

From here on it's downhill. To secure complete cut off of the steam supply during scheduled shut-downs of the bottling run, solenoid valves were provided to supplement normal modulating action of the controls. To discharge widely varying loads of condensate continuously and remove immediately all air and incondensible gases, Sarco Float Thermostatic Steam Traps were installed on all condensate outlets. On the drips before each control valve a Sarco Thermo-Dynamic Steam Trap was installed to insure delivery of dry steam. Sarco Pipeline Strainers were installed before all steam traps and valves to protect them against damage by any foreign bodies. And thus ends a classic story of the grape.

Still, this story has been condensed far too much, really, and we feel you've been cheated out of the story's more delicious details. You needn't be, however. We've printed the facts in detail for posterity and you in Sarco Case History 185, complete with drawings that practically make it a do-it-yourself kit. If you would like a copy, we will be flattered to receive your request, and dispatch it with dispatch.

## WE'RE ALWAYS IN . . . AND THE WELCOME MAT'S OUT

We always take it for granted that if you are going to be in the vicinity of our plant you'll phone or drop us a line so we can invite you to visit us. You'll find that our factory in Bethlehem, Pennsylvania, is on many well-travelled routes, and that our steam laboratory has much to offer in interest and helpfulness. Forgive us for being immodest, but the lab is the most up-to-date of its kind in the country.

When you visit us, don't allow yourself to get sidetracked by the drill presses and automatic lathes. We're proud of this equipment but you've probably seen metal mutilated before, and it's our steam laboratory that's unique. We promise you a good show, and if you have any problems, bring them along. We'll solve them while you wait.

## ANYONE FOR KEY CHAINS?

Need a key chain? A tiny replica of a Sarco Thermo-Dynamic Steam Trap, Type TD-50 is attached but you can always remove it if you find it too commercial. There are many things you could use these chains for. Fishing sinkers? Lengthening a light cord? Even holding keys? Anyway, if your Sarco representative is out, write in.

**Pardon our monopolizing the conversation in this series of paid communiques, but we're trying our best to interest you in certain subjects that concern us both—to the point where you'll communicate.**

6355

SARCO

SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.

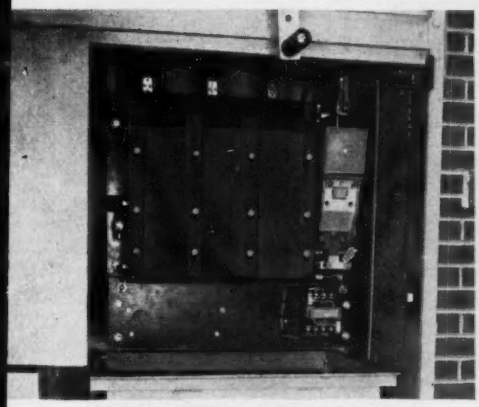
STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES



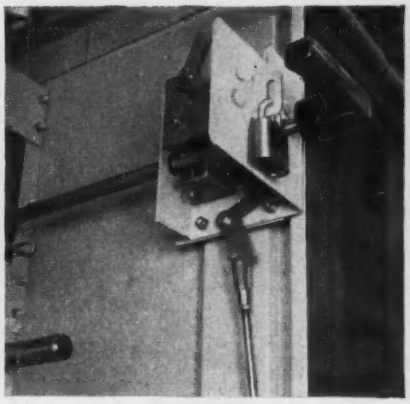
For more facts circle 809 on Reader Service card, p 197

## NEW MEDIUM-VOLTAGE STARTERS FOR SEMI-HAZARDOUS DUTY

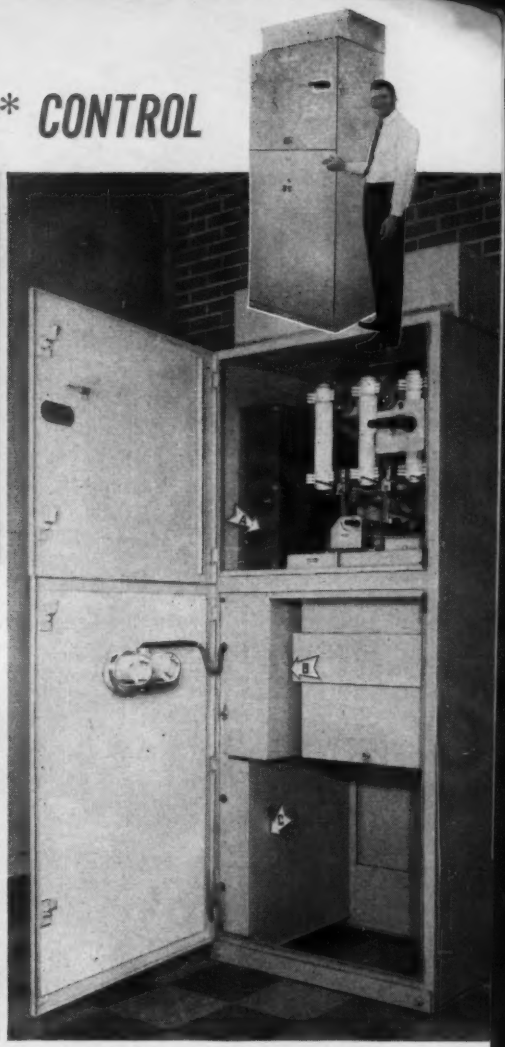
# OIL-IMMERSED LIMITAMP* CONTROL



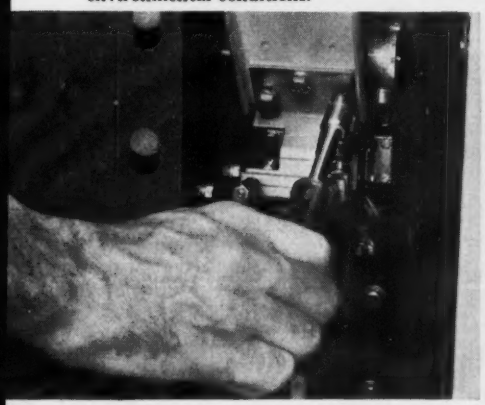
400-amp, oil-blast contactor has interrupting capacity of 50,000 kva for reliable operation and equipment protection in all environmental conditions.



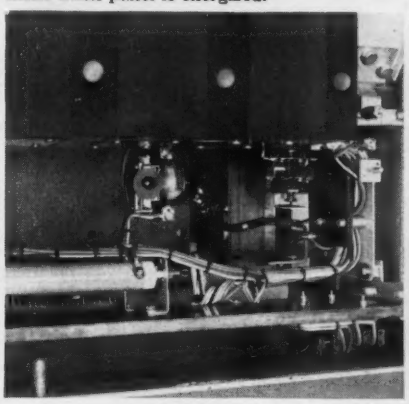
Advance-design interlocking prevents opening of isolating switch if contactor is closed; denies entrance to high-voltage compartment when panel is energized.



Isolation barrier system (A, B, and C) segregates high-voltage points for installation of motor cables when bus is energized and isolating switch is open.



All maintenance and inspection of contactor and control components can be done with oil-blast tank lowered. Control is front connected for accessibility.



Oil-immersed control-power interlock in primary circuit of the control-power transformer assures that no current is broken when the isolating switch is opened.

# NOW safer operation, superior protection with new General Electric Limitamp Control

Safer operation plus maximum equipment protection are yours when you specify new General Electric Oil-immersed Limitamp control . . . the medium-voltage motor starter for use in semi-hazardous and corrosive environments, as well as in many general-purpose applications throughout industry.

**Positive equipment protection** is inherent in the design of General Electric Oil-immersed Limitamp control. Current-limiting fuses interrupt faults within the first half cycle, before damage occurs. The 50,000-kva oil-blast contactor rapidly interrupts motor current during all overload conditions. Control components are oil-immersed for long life and maximum protection against contaminants.

General Electric's Oil-immersed Limitamp control employs industry's most advanced interlocking system for **operating and maintenance personnel safety.** The isolating-switch handle and high-voltage compartment door are mechanically and electrically interlocked with the contactor. Only when the isolating-switch handle is in the "Open" position can personnel enter the high-voltage compartment.

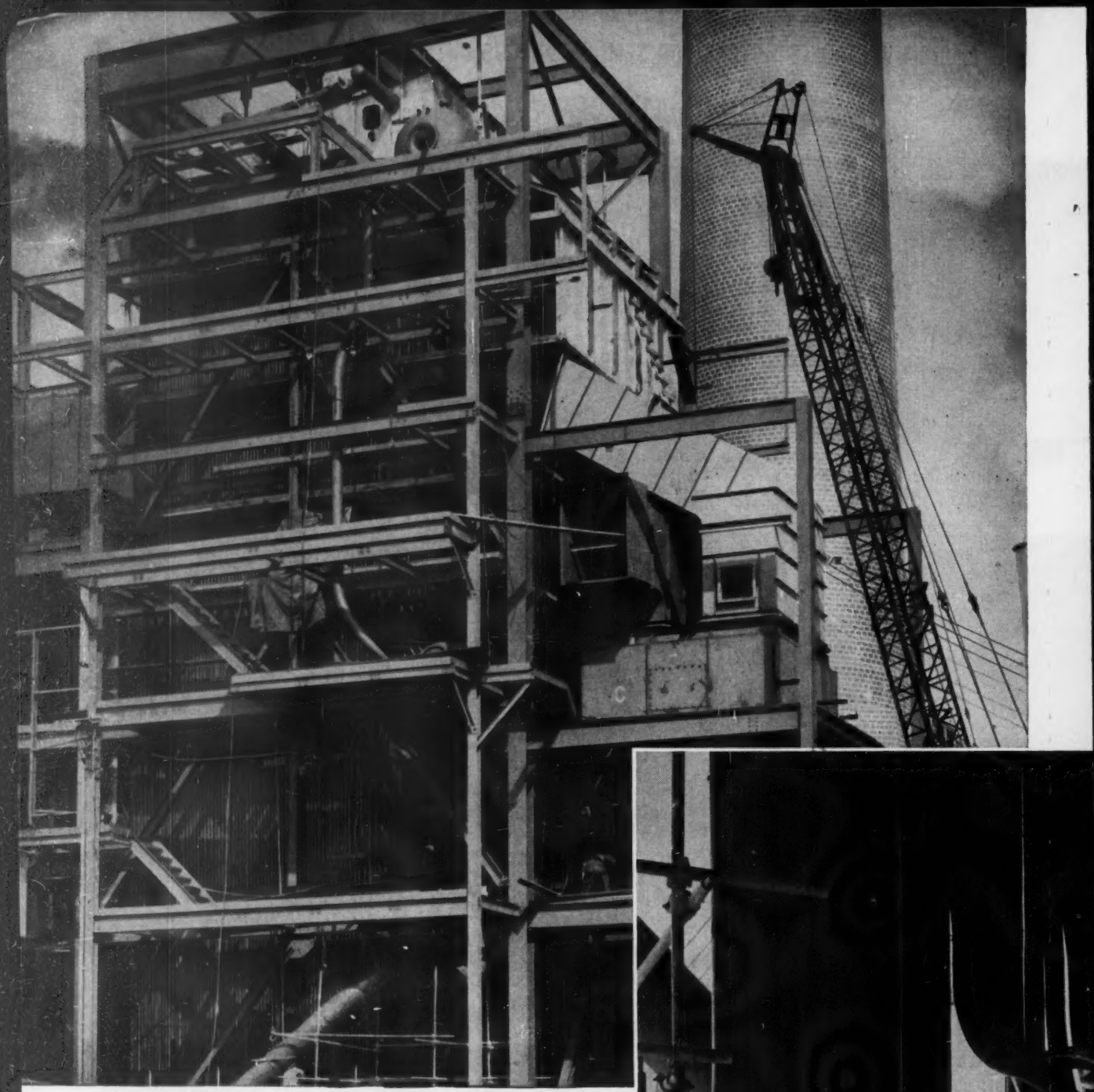
For full information on new Oil-immersed Limitamp control—for motors rated up to 1500 hp at 2300 volts, and 3000 hp at 4600 volts—contact your G-E Sales Engineer or Agent. Or, write Section 783–18, General Electric Co., Schenectady, N. Y., for Bulletin GEA-7236. ***Industry Control Department, Salem, Va.***

*Reg. Trade-mark of General Electric Company.

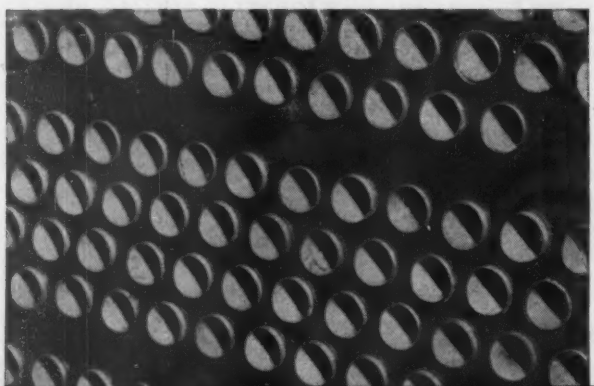
*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

For more facts circle 810 on Reader Service card, p 197



**REPUBLIC ELECTRUNITE STAINLESS STEEL HEAT EXCHANGER TUBING** resists corrosion and provides long trouble-free service for main surface condensers in utility power plants where water is used directly from natural sources. Call your Republic representative for additional information, or send coupon.



**REPUBLIC ELECTRUNITE BOILER TUBES** reduce installation time and operating costs because quality is built-in. Full normalizing, uniform wall thickness, and true concentricity assure easy workability and in service dependability. Bends are smooth and uniform. Rolling-in operations easier. The Riley RX Unit, above, is an addition to the Tallahassee municipal power plant at St. Marks, Florida.

# *Tallahassee "powers up" with*

# REPUBLIC ELECTRUNITE BOILER TUBES

When more power was needed to meet the growing needs of growing Tallahassee, the city authorized Riley Stoker Corporation to design, engineer and erect a new RX Boiler unit.

Riley tubed both boiler and water walls of this new unit with Republic ELECTRUNITE in 2½" and 3¼" sizes. With the ELECTRUNITE Tubes rolled-in, the Riley RX operates at a continuous unit capacity of 220,000 lbs. of steam per hour, with an operating pressure of 1050 psi, at 950°F.

You can trust Republic ELECTRUNITE Boiler Tubes always to roll-in easily. Because, the ELECTRUNITE process assures true tube concentricity, uniform ductility, freedom from hard spots. Uniform wall thickness and diameter, too. Bends are smooth, wrinkle-free, uniform. You never tubed it so good!

This quality tube is produced to meet ASTM specifications, ASME Boiler and Pressure Vessel Code, Federal and State committees, and boiler insurance requirements.

Power up your equipment with the one tube everybody trusts . . . for performance, dependability, and initial economy. Contact your Republic representative, or return coupon below for facts.

**FARROWTEST REJECT TABLE**

| Wall Thickness (B.W. Gage) | Minor dimension of the defect (Length or Depth) | Defective Area (Length, Depth Plane) |
|---|---|---|
| 20 | .006" | .0025 sq. inches |
| 18 | .006" | .003 sq. inches |
| 16 | 12½% of wall | .003 sq. inches |
| 14 and 13 | 12½% of wall | .004 sq. inches |
| 12 and heavier | 12½% of wall | .005 sq. inches |

**FARROWTEST** detects and rejects not only tubing containing defects which completely penetrate the wall; but also tubing with defects equal to, or greater than, those shown in this table. For irregular defect shapes, a tube with defect area equal to or greater than shown above is rejectable. Where required, sensitivity of FARROWTEST equipment can be calibrated to reject defects of lesser specified area than shown in table, at extra cost.

**FARROWTEST—QUALITY YOU CAN MEASURE.** Not a mere laboratory theory, not a mere inspection tool, but an exclusive eddy-current production line test that detects and rejects tubing containing defects of critical size. FARROWTEST is offered as an alternative to other less positive tests in accordance with the table above, at no extra cost.

REPUBLIC STEEL

**REPUBLIC STEEL**

**REPUBLIC HAS THE FEEL FOR MODERN STEEL**

Steel

Strong, Modern, Dependable

**REPUBLIC STEEL CORPORATION**
**DEPT. PO-1681-A**
**1441 REPUBLIC BUILDING • CLEVELAND 1, OHIO**

Please send more information on the following products:
☐ Republic ELECTRUNITE® Boiler Tubes ☐ FARROWTEST®
☐ ELECTRUNITE Stainless Steel Heat Exchanger Tubing

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

For more facts circle 811 on Reader Service card, p 197

## A STANDOUT UNDER ANY TEST

# DETROIT ROTOSTOKER C-C (Continuous Cleaning)

**In any test you want to apply DETROIT ROTOSTOKER C-C (Continuous Cleaning) will stand out**

Detroit RotoStoker C-C (Continuous Cleaning) with reciprocating grates that continuously clean the fire and discharge ash at the front, where it may be taken from the ash pit at floor level if desired, avoiding need for a basement ash bunker. High sustained efficiency, high availability low power for operation — For boiler capacities from 5,000 to 75,000 pounds steam per hour.

Efficiency, availability, flexibility under fluctuating load, ability to burn good or low grade coals or waste materials, durability, low parasite power consumption and low maintenance. RotoStoker C-C scores high on all points.

Among those who have tested the RotoStoker C-C — found it a winner — are such well known names as:

**Allied Chemical & Dye Corporation**
**Alpena Power Company**
**American Cyanamid Company**
**American Radiator and Standard Sanitary Corp.**
**The Electric Auto-Lite Company**
**Automatic Electric Company**
**Carlisle Tire & Rubber Company**
**Columbian Carbon Company**
**Darling and Company**
**E. I. du Pont de Nemours and Company**
**General Motors Corporation**
**General Tire & Rubber Company**
**Manchester Board and Paper Company, Inc.**
**National Gypsum Company**
**Newberry State (Mich.) Hospital**
**Pittsburgh Steamship Company**
**U. S. Dept. of Defense**
**Wake Forest College**

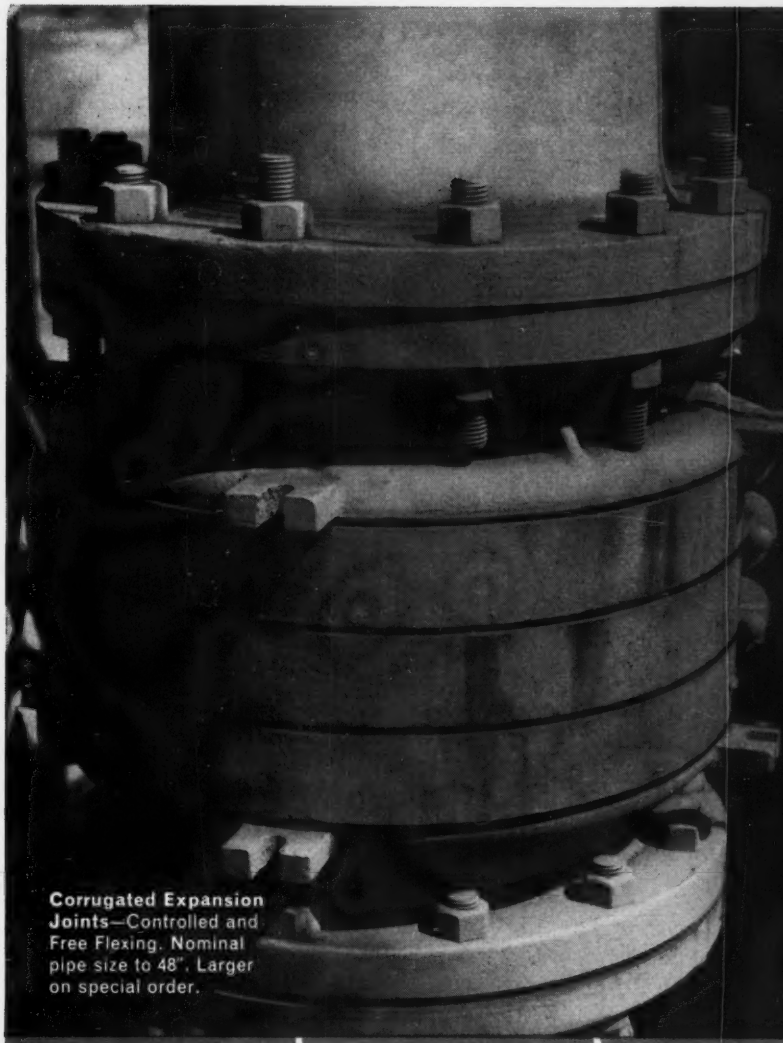


RotoStoker C-C is typical of the Dependable Detroit Line which includes stokers for efficient firing of boilers from 3,000 to 400,000 pounds per hour steam capacity.

DETROIT STOKERS COST LESS: COST EQUALS INITIAL INVESTMENT PLUS UPKEEP PLUS PRODUCTION LOSSES DUE TO EQUIPMENT OUTAGE. THE TOTAL IS LESS WITH DETROIT.

8139

Write **DETROIT STOKER COMPANY**
DIVISION OF UNITED INDUSTRIAL CORPORATION
MAIN OFFICE AND WORKS • MONROE, MICHIGAN
District Offices or Representatives in Principal Cities

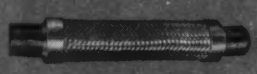


**Corrugated Expansion Joints**—Controlled and Free Flexing. Nominal pipe size to 48". Larger on special order.

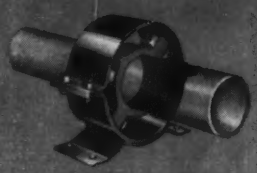
## ONE SOURCE...
## ONE RESPONSIBILITY...
## FIVE SOLUTIONS TO PIPE MOVEMENT PROBLEMS

Flexonics . . . and only Flexonics offers you one responsible source to insure sound piping installations where thermal expansion and contraction, vibration, and other forms of pipe motion exist. Mail the coupon for your FREE copy of the new Flexonics Engineering Guide . . . 42 pages of pipe motion calculations, tables, anchoring and guiding data.

**Expansion Compensators**—Low and high pressure models. Available in steel, all stainless steel, and bronze.



**Flexible Connectors**—Bronze and hot dipped galvanized steel. Pipe size to 14". Nipple, weld, or flange ends.



**Pipe Alignment Guides**—All steel construction for pipe size ¾ to 24". Moves axially in segmented steel cylinder.

**Roller Pipe Insulating Supports**—All steel, formed saddle. Pipe sizes ¾" to 14". Larger sizes on special order.

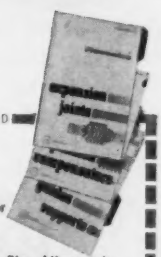
EJ-280

# Flexonics

DIVISION OF CALUMET & HECLA, INC.
382 East Devon Avenue • Bartlett, Illinois

FLEXIBLE METAL and SYNTHETIC HOSE, EXPANSION JOINTS
BELLOWS • SPECIAL TUBULAR ASSEMBLIES

In CANADA
FLEXONICS CORPORATION OF CANADA, LTD.
BRAMPTON, ONTARIO



ATTACH TO YOUR LETTERHEAD

Flexonics
382 E. Devon Ave.
Bartlett, Ill.

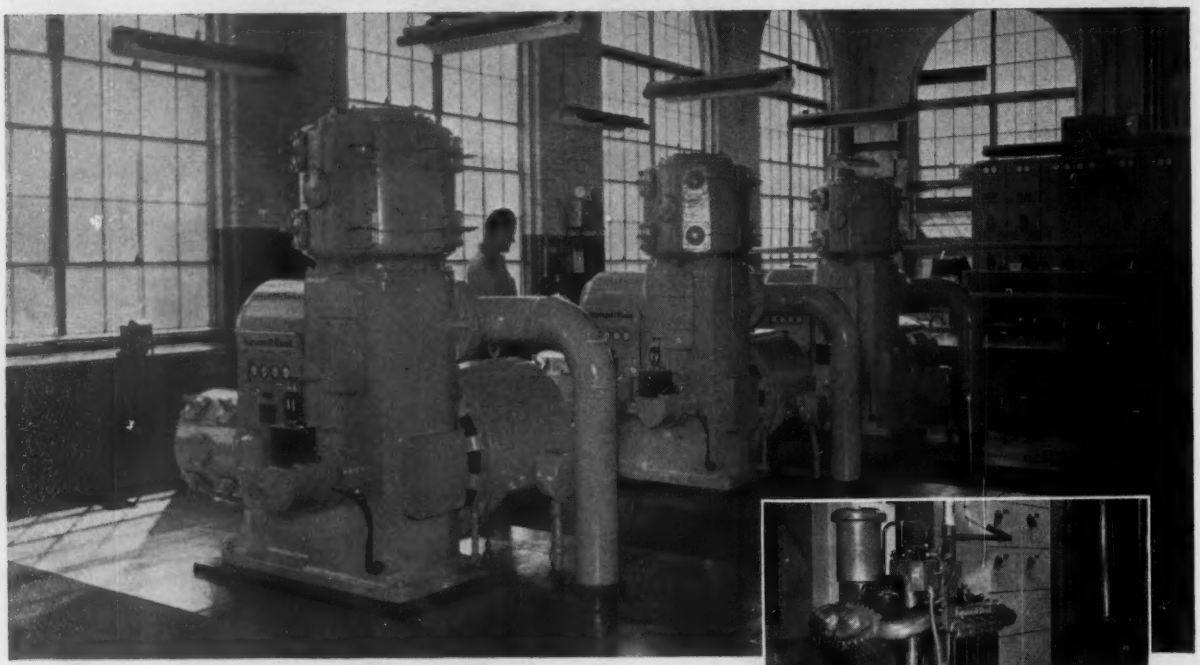
Please send me Flexonics Engineering Guides and other information in the areas that I have checked:

☐ Flexonics Expansion Joints
☐ Pipe Alignment Guides & Supports
☐ Flexonics Expansion Compensators
☐ Flexonics Flexible Connectors

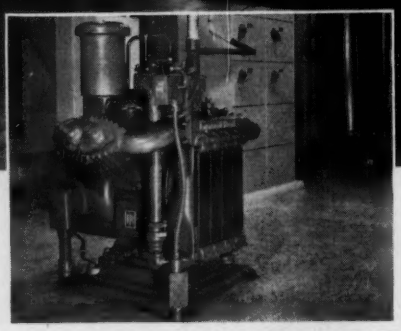



For more facts circle 813 on Reader Service card, p 197

# How to squeeze more profits out of your COMPRESSED AIR POWER



Three 125-hp XLE compressors generating air power for a weapons plant. This compact two-stage unit features pipeless Thru-Frame air flow and full-floating aluminum bearings which never need adjustment. Sizes 125 to 350 hp. (Other I-R air compressors to 4000 hp.)



This air-cooled two-stage Type 40 compressor is one of several furnishing plant air and instrument air in a power plant. Sizes 25 to 125 hp. (Others from ½ hp.)

## *Make sure you have enough pressure at point of use—and extra dependability at point of generation*

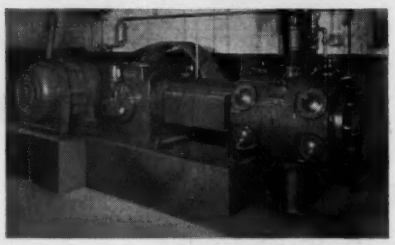
Cost-conscious plant engineers and production men know that to get the full savings inherent with air-powered equipment, you must have full air pressure at every tool.

But it's equally important to guard against unscheduled shutdowns where your air power is generated. This problem can best be solved at the time of purchase, by specifying compressors that have an extra margin of safety against mechanical troubles.

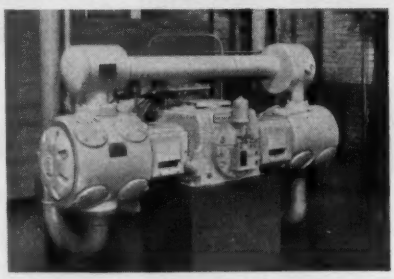
Ingersoll-Rand compressors have that extra safety margin built in. They'll stay on the job longer, with minimum attention and maintenance. Take valves, for example—the most "vulnerable" point in any compressor. Only I-R compressors have Channel Valves, known the world over for efficiency, quiet operation and long life. Their exclusive air-cushioned action eliminates impact and greatly reduces wear.

Also in I-R compressors, all running parts are sealed against dust and dirt which might cause wear. The seal need never be broken, since bearings are a type which will never need adjustment.

For top compressor performance and long-run economy, specify Ingersoll-Rand. And ask your I-R representative to show you how to get your maximum "*Dividend on Payroll Dollars*" with a Planned Annual Review of your air power system.



Ingersoll-Rand's new ESH horizontal compressor, here in a tool factory. Sizes 20 to 150 hp. Also built as vertical unit, called ESV.



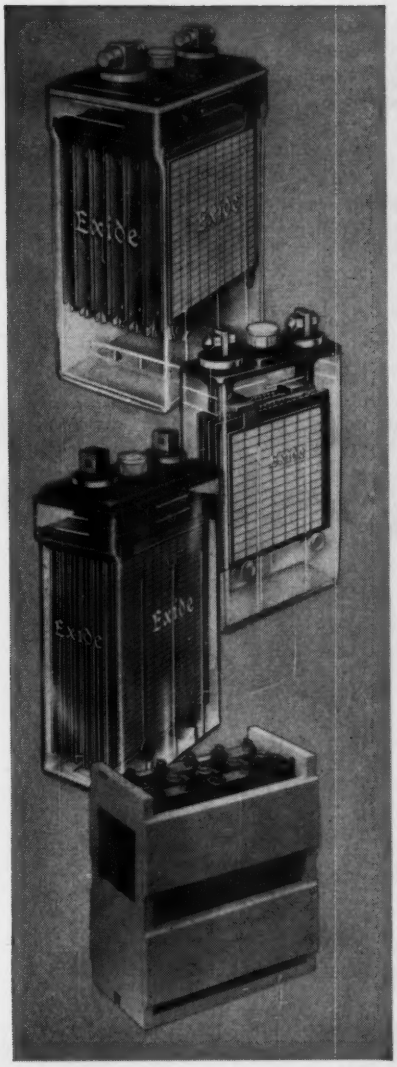
Two-stage balanced-opposed PHE compressor handling air in a gas plant. Also built as L-design unit with packaged intercooler. Sizes 75 and 100 hp.

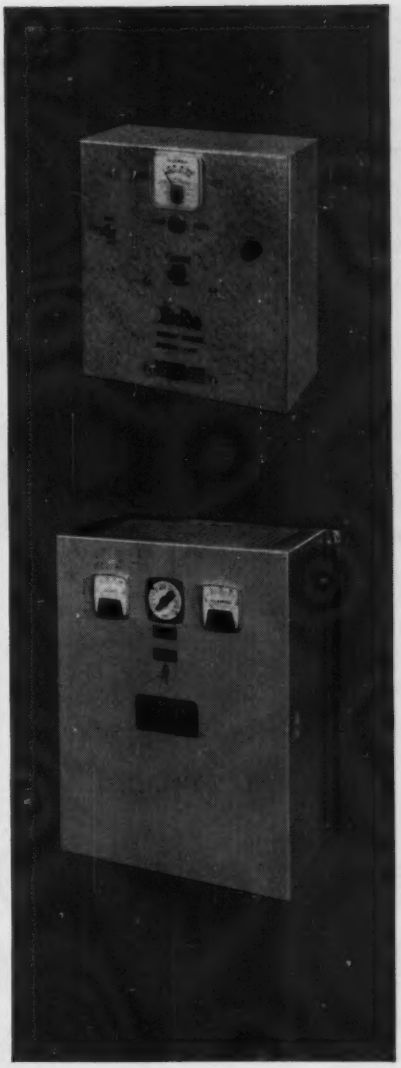
**Ingersoll-Rand**

1-915

11 Broadway, New York 4, N.Y.

**COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS**



# How to be sure you're right when you buy battery power

**First.** Make sure your battery is selected on a basis of engineering information. This is how your Exide man makes his recommendation. Because the Exide line includes the broadest range of battery types, he is able to show you factually which particular type is best for you —flat plate Tytex with Silvium* or calcium, long life Exide-Manchex Planté type with Silvium, low maintenance pocket positive nickel-cadmium, or new 20-year Exide-Ironclad tubular with Silvium.

**Second.** Make sure your charger is engineered to meet the needs of your batteries. Exide chargers come in types and sizes to cover all charging requirements. Correct charging methods prolong battery life and reduce operating and maintenance costs. Choice of either constant voltage, trickle or Hi-Lo type chargers.

**Third.** Make sure you arrange for service provided by industrial battery specialists. It's included when you get an Exide power package. And it covers both your batteries and chargers. Over 200 Exide factory-trained field men coast to coast are ready to give you fast, competent service. Write for details on the complete Exide power package. Exide Industrial Marketing Division, The Electric Storage Battery Company, Phila. 20, Pa.

*Silvium is Exide's patented corrosion-resistant grid alloy

Exide®

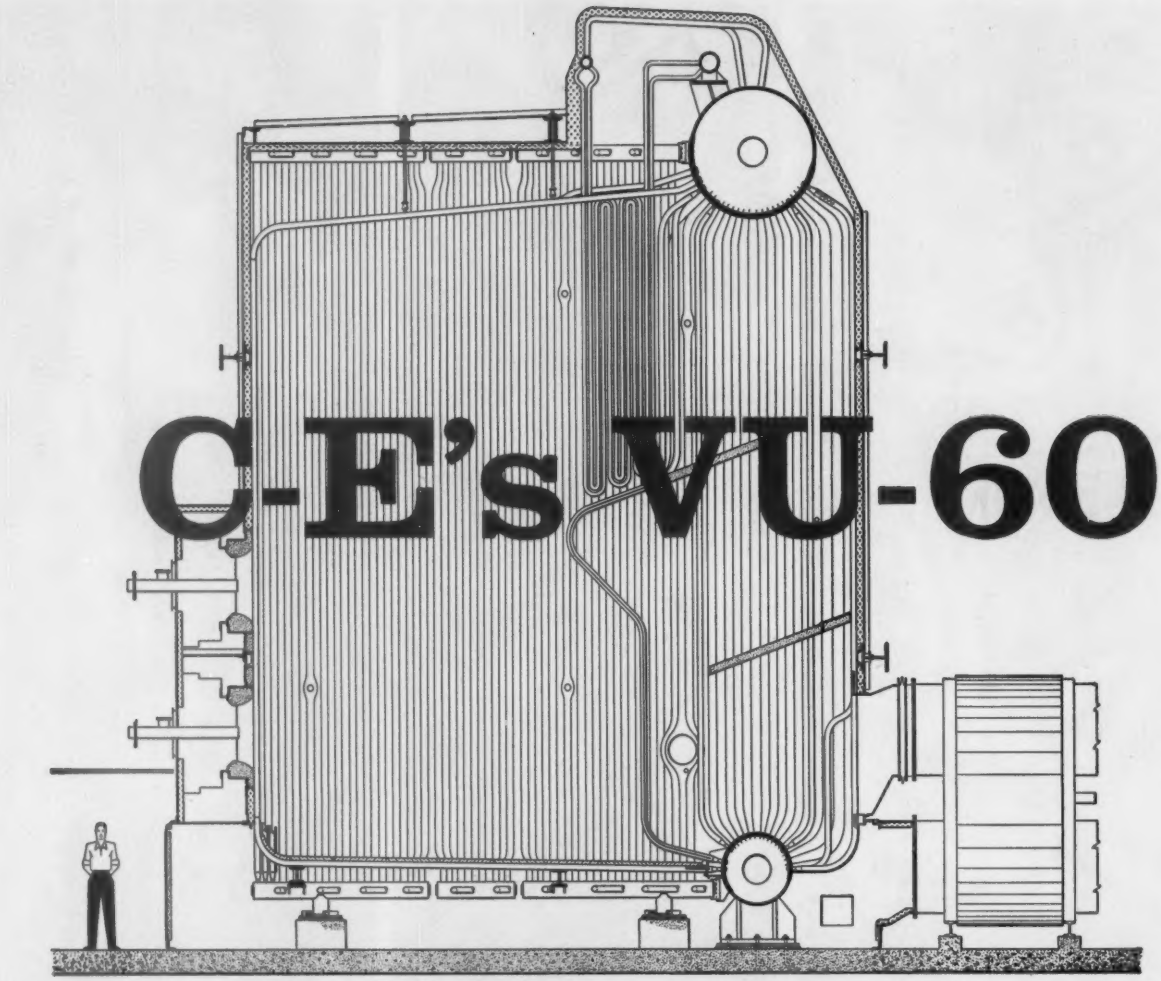
INDUSTRIAL MARKETING DIVISION
The Electric Storage Battery Company

ESB

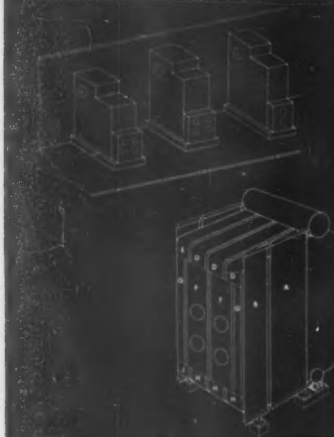


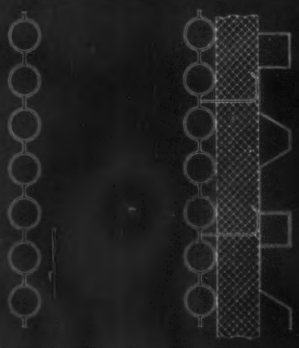
For more facts circle 815 on Reader Service card, p 197

# C-E's VU-60

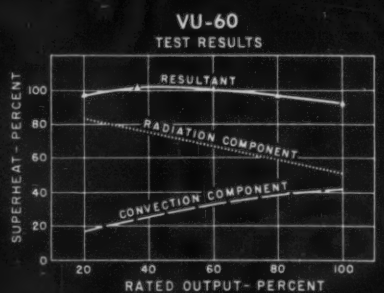


## SOME DESIGN HIGHLIGHTS OF THE VU-60










**Modular increments allow assembly of custom designs from standardized components; boiler can be proportioned for best combustion, heat absorption, gas flow — even where space conditions are difficult.**

**Completely self-cased, the VU-60 is an all-welded pressure-tight envelope composed of modular panels of finned tubes; fewer field welds cut erection time.**

**Insulation and preformed lagging go directly over tube panels, thus reducing non-working weight per pound of steam generated.**

**Characteristic of Combustion's VU-60. This superheater curve indicates a temperature stability throughout entire load range.**

**ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER**

# GIVES YOU A CUSTOM-DESIGNED BOILER BASED ON STANDARDIZED MODULAR COMPONENTS

**Because of its unique modular concept, C-E's new VU-60 offers unusual flexibility and can be designed to meet unusual or difficult space conditions.**

## VU-60 SPECIFICATIONS

| | |
|---|---|
| Capacities: | 100,000 to 250,000 lb per hr |
| Design pressures: | 250, 500, 750, 1040 psi |
| Steam temperatures: | to 900F |
| Fuels: | Oil and/or gas |
| Firing: | Horizontal (front wall) or tangential |
| Size increments: | Depth-twelve<br>Width-eight<br>Height-three |
| Steam drum sizes: | Four |

The VU-60 is a completely self-cased boiler. Finned tubes, shop-welded into modular panels, make up the exterior walls of the unit. The fins joining the panels are field-welded to make a pressure-tight envelope. Insulation is applied directly over these walls and is covered by pre-formed, field-installed metal lagging. The need for bulky or heavy nonworking structural members is kept to a minimum.

The VU-60 can be designed to meet your most exacting steam needs. It is easy to install, economical and dependable in operation, completely accessible and functional. Why not get full information on how this new concept can fulfill your specialized requirements?

# COMBUSTION ENGINEERING

General Offices: Windsor, Conn., New York Offices: 200 Madison Avenue, New York 16, N. Y.
Canada: Combustion Engineering-Superheater Ltd.

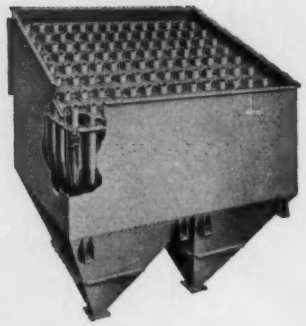
C-322

MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE



For more facts circle 816 on Reader Service card, p 197

# TWO COST-SAVING ADVANTAGES OF CYCLO-TRELL MECHANICAL DUST COLLECTOR

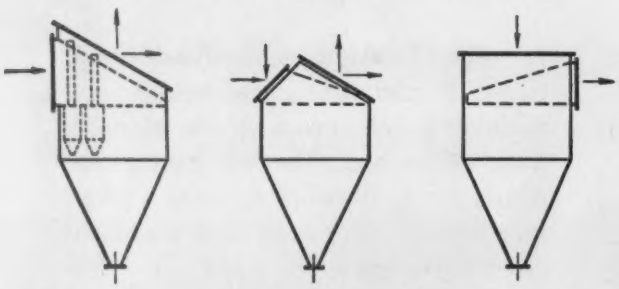


## Flexible Design For Low First Cost

Cyclo-trells have been engineered to provide the most economical solution to many gas cleaning problems.

Cyclo-trell's flexible design permits a wide combination of:

- standard 10″, 24″, 24″-lined, IC* and IC-lined collecting tube sizes
- standard inlet and outlet locations
- standard arrangements of the tubes



Most installations are engineered with a combination of these Cyclo-trell designs.

Whenever an installation requires a configuration different from the standard types shown, Research-Cottrell draws on its 49 years of gas cleaning experience in designing a custom-built unit. These custom units may be of the multiple tube or involute design, and are for power, cement, coal drying, chemical, petroleum, mining, quarrying, metals industry, or other applications.

Research-Cottrell engineers have also had wide experience in combining Cyclo-trell collectors with existing precipitators to increase collection efficiencies. This is particularly important when boilers are operating at increased loads and where higher collection efficiencies are required.

* Involute Cyclo-trell

## Longer Tube Life for Low Maintenance Cost

Actual operating experience in the field has proven that Research-Cottrell tubes last longer.

This experience has led many users of dust collectors to specify Cyclo-trell tubes as replacements.

Two tube types are available. Standard chrome-vanadium tubes having a Brinell Hardness of 290-350, or, at a nominal price addition, for extremely abrasive conditions, tubes having a Brinell Hardness of 500-550 can be supplied. Outlet wear plates are included with the higher Brinell types.

**Contact your nearest Research-Cottrell office for complete information on Research's line of mechanical collectors and electrostatic precipitators, or write our main office for Bulletin 300.**

**Research-Cottrell**

RESEARCH-COTTRELL, INC., Main Office and Plant: Bound Brook, N. J.
Representatives in principal cities of U.S. and Canada.

8C238

MEMBER OF THE INDUSTRIAL GAS CLEANING INSTITUTE

For more facts circle 817 on Reader Service card, p 197

For more facts circle 818 on Reader Service card, p 197

# "Forgot we even had that one"

That's a typical reaction of Gardner-Denver air compressor owners when they check on compressed air costs. But this heavy-duty compressor never forgets. It keeps delivering dependable air power—on a continuous basis. Write for Bulletin HAC-40.

Gardner-Denver Company, Quincy, Illinois—Offices in principal U.S., Canadian and Mexican cities
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Ave., Toronto 16, Ontario

International: Gardner-Denver International Division, 233 Broadway, New York 7, N.Y.
International Offices: Buenos Aires, Argentina; Artarmon, N.S.W. Australia; Brussels, Belgium
Rio de Janeiro, Brazil; Santiago, Chile; Barranquilla, Colombia; Lima, Peru; Ndola, N. Rhodesia;
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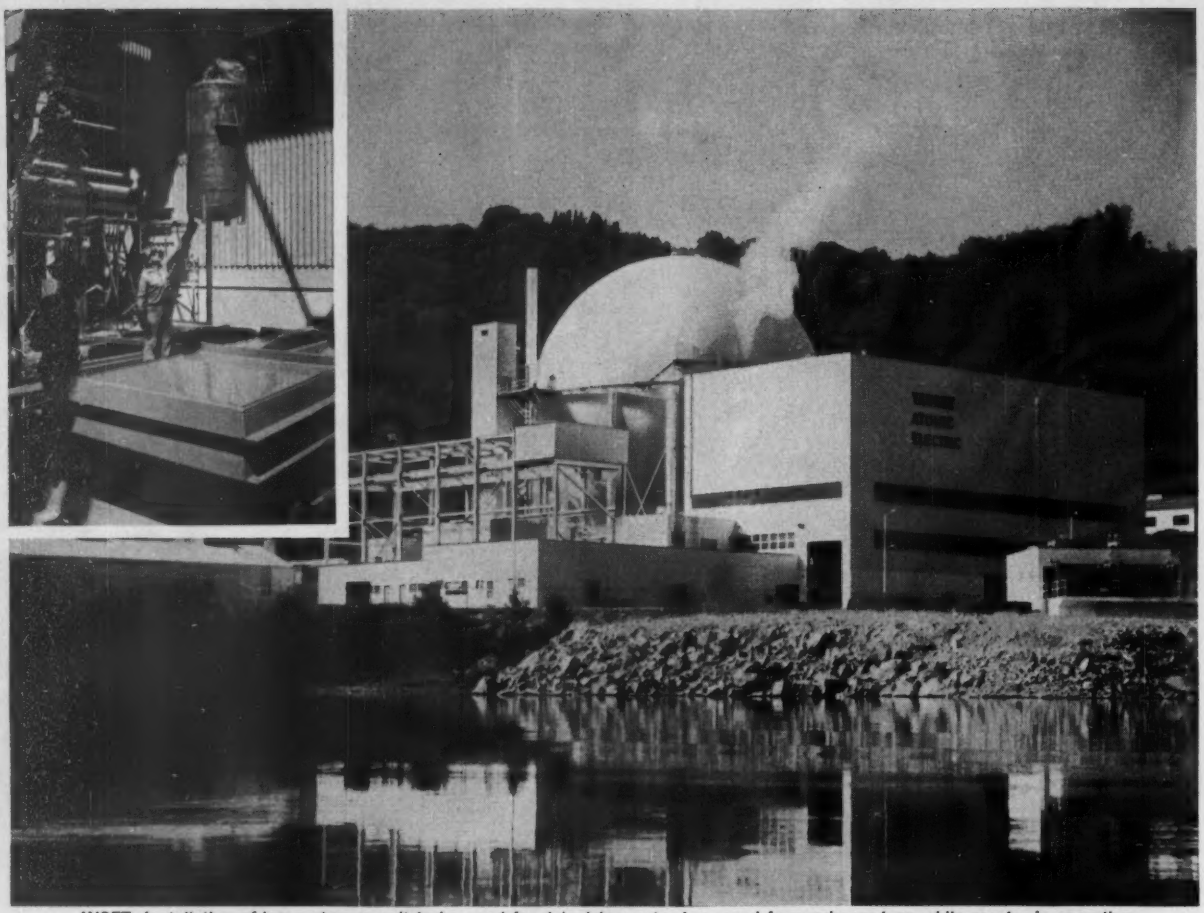
GARDNER-DENVER Since 1859

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

**GARDNER - DENVER**



INSET: Installation of ion exchange unit to be used for deionizing water bypassed from primary loop while reactor is operating.

# How do your ion exchange requirements compare with those of Yankee Atomic Electric?

AMBERLITE® ion exchange resins do three critical jobs for Yankee Atomic Electric Company, at this new 136,000 kw. atom-powered station in Rowe, Mass.: (1) The most important is to provide reactor-grade makeup water for both primary and secondary loops of the pressurized water reactor. Raw water is taken from the Deerfield River, clarified and filtered, then passed over AMBERLITE IR-122 cation exchanger and AMBERLITE IRA-400 anion exchanger. (2) Water is continuously bypassed from primary loop and passed over AMBERLITE XE-150 to remove ionic impurities formed by corrosion reactions. (3) AMBERLITE XE-78 is used to remove borate ions from primary coolant water after cold shutdowns (boric acid solution is used to stop the nuclear reaction when the reactor is cooled below normal operating temperature).

Whether or not your water conditioning requirements are as stringent as these, Rohm & Haas can supply you with ion exchange resins that will serve you efficiently and economically. We will gladly furnish technical information on our complete line of AMBERLITE ion exchange resins.

**Write for this free booklet of case-history information on the many ways industry is using AMBERLITE ion exchange resins.**

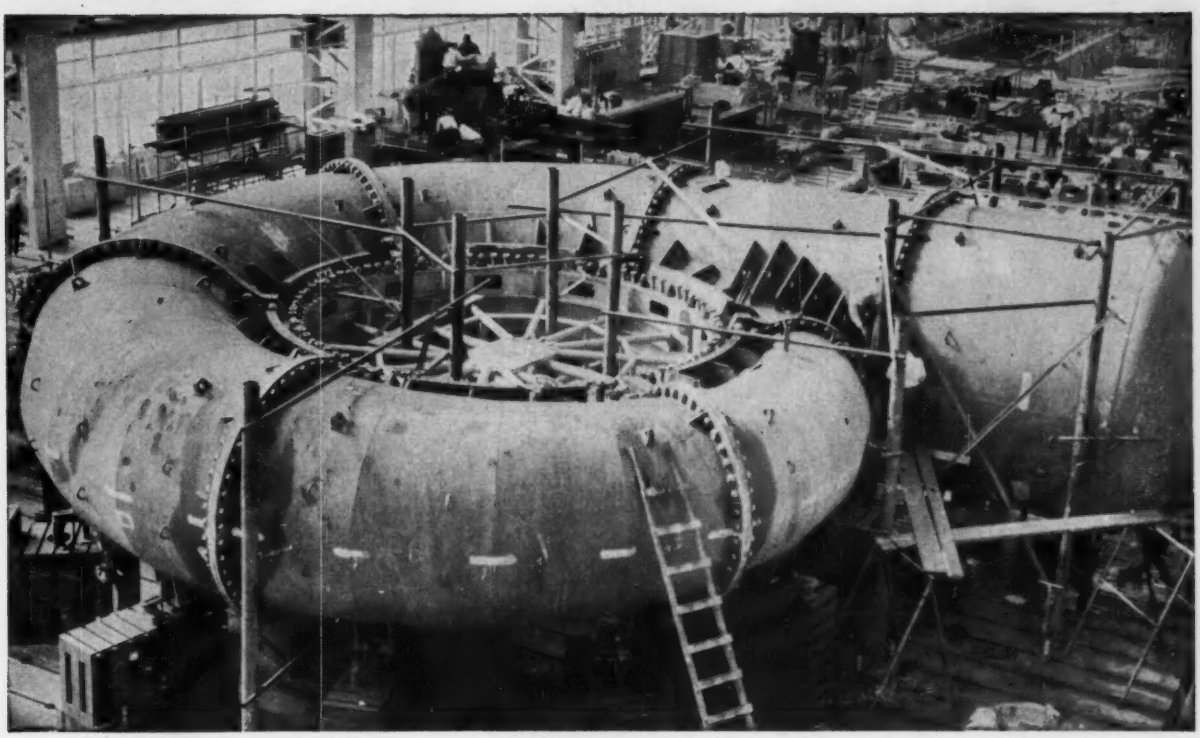
ROHM & HAAS

PHILADELPHIA 5, PA.

# AMBERLITE

# HITACHI

## now completing the first hydraulic turbines for Thailand's Yanhee Project



Shop tests were recently completed on the spiral casing for the first of two 115,000 HP Francis-type turbines being completed by Hitachi for Thailand's Royal Irrigation Department. These will be the first of the planned 8 sets of generating units to be installed at the downstream of the Bhumiphol Dam, as part of the Yanhee Multipurpose Project which will commence operation in 1963 and eventually supply 560,000 kW of power to Bangkok and Thonburi. The vertical shaft Francis turbines have been designed to deliver 115,000 HP under the effective head of 112m and for a speed of 150 rpm. Their spiral casings, with inlet diameter of 4150mm, will each be divided into 7 sections for transportation by barge up the Ping River to the site.

Hitachi, Ltd.
Tokyo, Japan
Cable Address: "HITACHY" TOKYO


For more facts circle 820 on Reader Service card, p 197

# With ONE-COTE CEMENT

# 5=6

Right! **5 BAGS OF ONE-COTE WILL COVER AS MUCH AREA AS 6 BAGS OF ORDINARY INSULATING-FINISHING CEMENT!**

Eagle-Picher ONE-COTE goes on in one single coat to the desired thickness . . . *does three jobs*—all in one quick and easy application . . . insulates . . . protects . . . finishes. Saves time, work and money! Effective for temperatures up to 1000 F.

For outdoor installations, Eagle-Picher One-Cote is quick-setting, withstands rain and moisture two hours after application. Contains a special rust-inhibitor to prevent rust. When used indoors, One-Cote requires no wire mesh or finishing treatment!

*Eagle-Picher produces a line of industrial insulations for all temperatures from below zero to over 2000 F. See our complete catalog in Sweet's Plant Engineering File or write for descriptive material.*

*Since 1843*

EAGLE EP PICHER

## EAGLE-PICHER

**The Eagle-Picher Company • General Offices**
**Dept. P-1061 • Cincinnati 1, Ohio**
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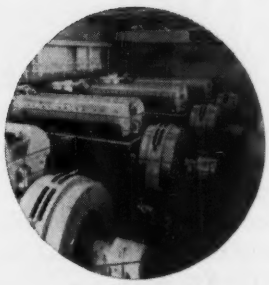
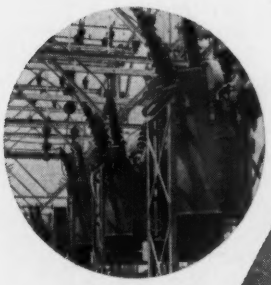
**For more facts circle 821 on Reader Service card, p 197**



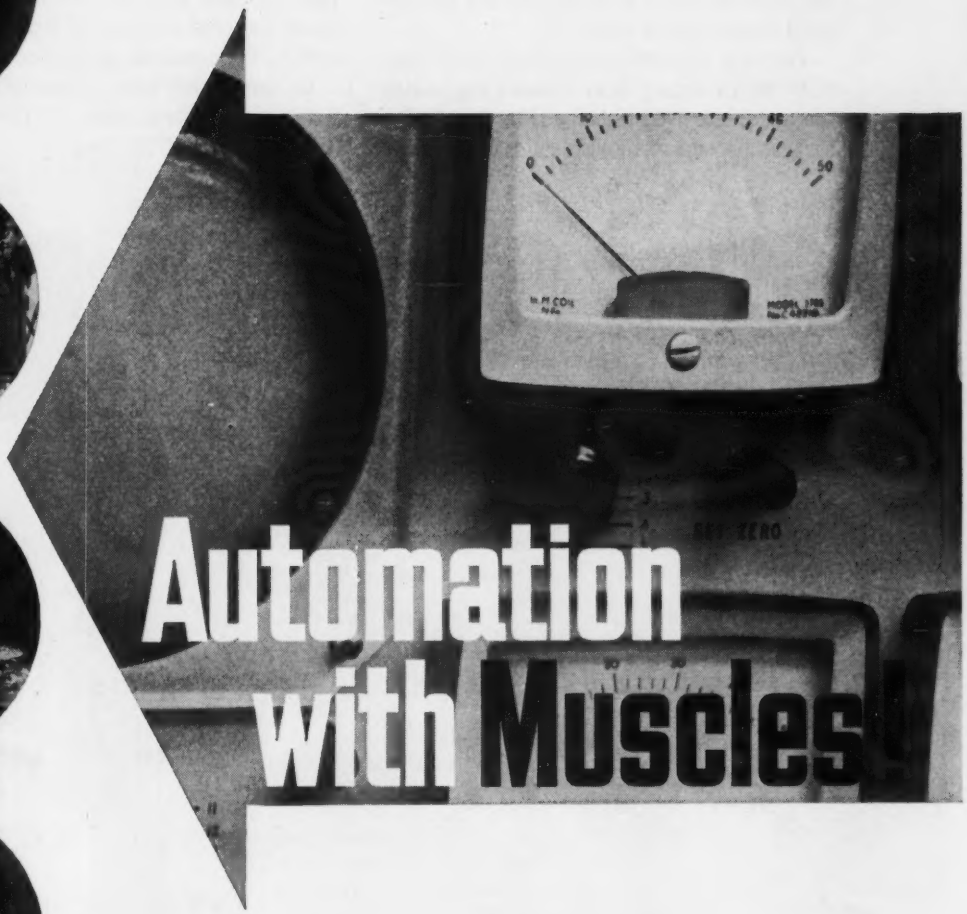
*Power Stations*



*Electrification*

*Harbour Installations*

*Sewage Plant*



# Automation with Muscles

## A NEW CONCEPT IN POWER ENGINEERING

Now, for the first time, comprehensive automated engineering schemes are available from one source — Hawker Siddeley Engineering. Backed by the vast resources of the Hawker Siddeley Group this newly formed Division of Hawker Siddeley Industries Ltd. offers a service unequalled by any other organisation. The advantages of a single supplier with centralised control are now available for electrical power systems, sewage plant, harbour installations, radio telescopes, automatic railway control equipment, automatic warehousing, automated manufacturing plant and telemetry applications. This is "Automation with Muscles". Hawker Siddeley Engineering will engineer and develop any of these schemes, with or without automatic and/or remote control. We have representatives throughout the world. Please write for further information.

## HAWKER SIDDELEY ENGINEERING

Duke's Court, Duke St., St. James's, London, S.W.1. Telephone: WHItehall 6177



For more facts circle 822 on Reader Service card, p 197

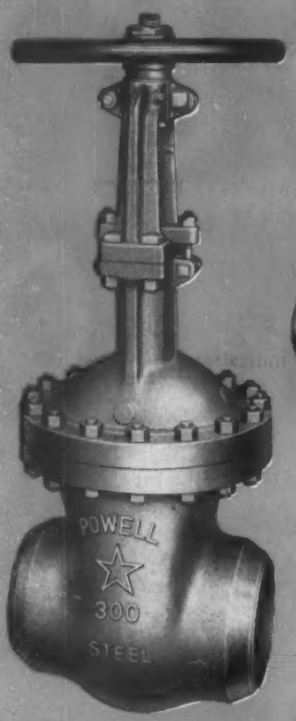
# YOU CAN COUNT ON POWELL VALVES

Performance proves it, year after year—you can count on Powell Valves to help you solve the toughest flow control problems of temperature and pressure found in power plants today.

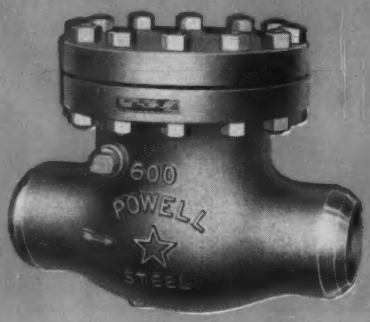
This truly dependable performance results from many things—among them Powell's engineering know-how, accumulated during 115 years of valve manufacture, and the consistent use of quality materials, quality controlled.

Then, too, you can count on getting the Powell Valve you need, when you need it. That's because Powell maintains a network of distributors backed up by factory inventories, warehoused "ready to go."

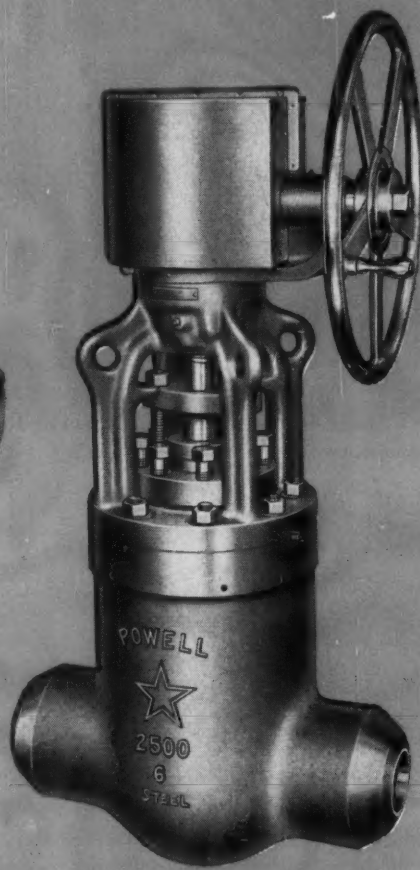
Get the full story from your nearby Powell Valve Distributor, or write us direct . . . The Wm. Powell Company, Cincinnati 22, Ohio.




300-pound Steel Gate Valve—Fig. 3003 WE. Bolted flanged yoke-bonnet. Outside screw rising stem. Interchangeable solid or split wedges, renewable seats. Sizes, 1" through 30".




600-pound Steel Horizontal Swing Check Valve—Fig. 6061 WE. Bolted cap, renewable seat and disc. Has full flow area when valve is fully open.




2500-pound Steel Pressure Seal Gate Valve—Fig. 125003 WE. Enclosed bevel gears facilitate operation. Valves can also be supplied with spur gearing or motor operators for remote control.

See our catalog in Sweet's

*115th year of manufacturing industrial valves for the free world*

**POWELL STEEL VALVES**

THE WM. POWELL COMPANY CINCINNATI 22, OHIO



For more facts circle 823 on Reader Service card, p 197

LOUIS N ROWLEY, EDITOR • OCTOBER 1961 • ESTABLISHED 1882 Power

# Plant design—1961

For us as energy-systems engineers, plant design forms a more or less constant preoccupation. And like many things we live with day by day, our concern can become mere habit. Right now—for what seem to me two compelling reasons—we need to break the routine, to give this key function the fresh and unfettered study conditions demand.

Economic conditions form the first of the compelling reasons I cited. After faltering for about a year, the American economy has begun to move forward again. It will continue to advance only to the extent that we can make production increasingly efficient and hence increasingly profitable.

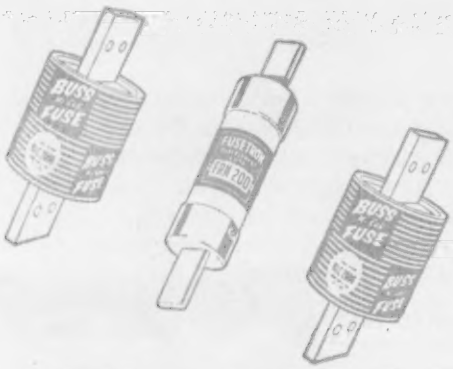
Nowhere is efficiency more critical than in the energy systems for which we are responsible, the systems that provide the power for production and the controlled environment in which production takes place. In its various forms, energy appears as part of the cost of all our products and services. Never has it been more important that *all* elements of cost be reduced. Put more positively, never has it been more important to design and operate efficient energy systems that yield more, better and lower-cost products.

Thus, if the American economy is to go forward and individual companies are to share fully in its growth, design of new energy systems and modernization of existing ones must receive intensified study. But there is a second and perhaps equally compelling reason why our concern with system design should not only be intensified but reawakened.

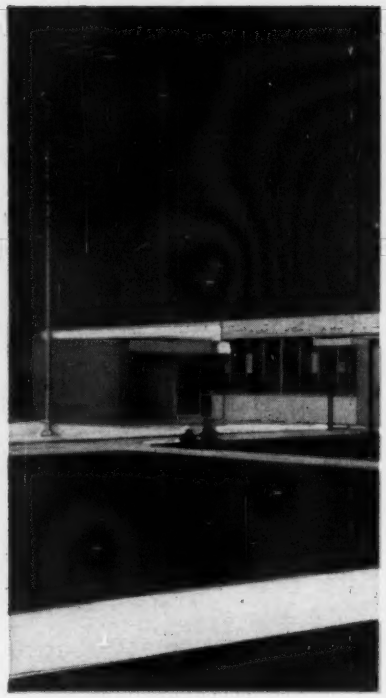
We are in the midst of a period of unusually rapid technical advance. New methods of energy conversion, sophisticated controls, exotic materials are but surface indications of a great ground swell of technological progress that may well revolutionize entire segments of the energy-systems field. Never have we as engineers needed to be more alert to the challenges and opportunities of new ideas—and never has it been more stimulating to study and explore them.

This *Plant Design Issue*, as did its predecessors, aims to help in two ways. Through its surveys of modern industrial electric systems, of pace-setting air-conditioning systems and of new steam and hydro installations, it puts on display current trends in plant design, exemplifies the answers energy-systems engineers have found to the problems of securing higher efficiencies at lower costs. In its comprehensive roundup of new products and design aids, this issue parades before you technical advances that have reached the market place, that are available now for your system planning and design. Finally, and perhaps most important, this October's staff-written reports size up for you the engineering thinking behind today's new developments and alert you to the directions tomorrow's technology will take.

This issue is, we believe, a unique package of plant-design information—use it to bring your energy systems to the peak efficiency that will build an increasingly profitable future for your company.




# Electrical Protection goes MODERN with BUSS Fuses...



# *in All-Electric Schools*

## *Utica Michigan*

● *Electricity* heats, lights, pumps water, cooks and operates all motor driven equipment in the West Utica and the Ewell Elementary Schools. No other utility service is used except the telephone.

The complete use of electrical energy puts special emphasis on the need to use the safest, most modern protective devices throughout the electrical system.

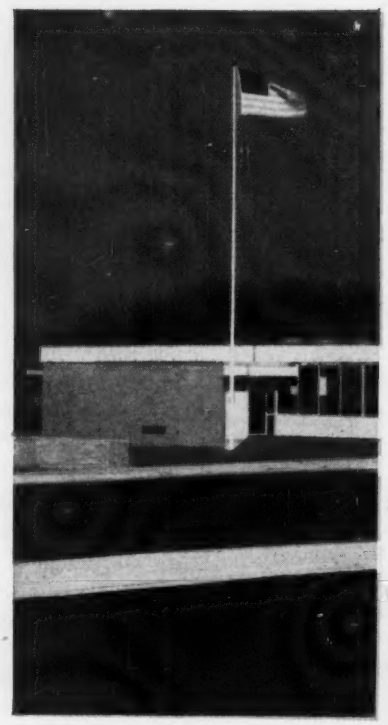
In each school, the main switchboard is protected by 3—1600 ampere BUSS Hi-Cap fuses having an interrupting rating of 200,000 amps. rms symmetrical. Thus, safe interruption of fault currents now available is assured,—and the fuses are adequately safe to allow for future system growth.

If a high fault current should occur, the fast opening characteristics of BUSS Hi-Cap fuses further protect the circuits and equipment against damage by restricting let-thru fault currents to safe value.

*Feeder and branch circuit protection*

To provide the safest short-circuit and overload protection . . . and to prevent needless outages,—FUSETRON dual-element fuses are used in the feeders and branch circuits of these schools.

For modern, all-purpose protection of circuits up to 600 amps., FUSETRON fuses cannot be equalled. They have 100,000 amp. interrupting capacity,—and sufficient time-lag to hold harmless overloads.

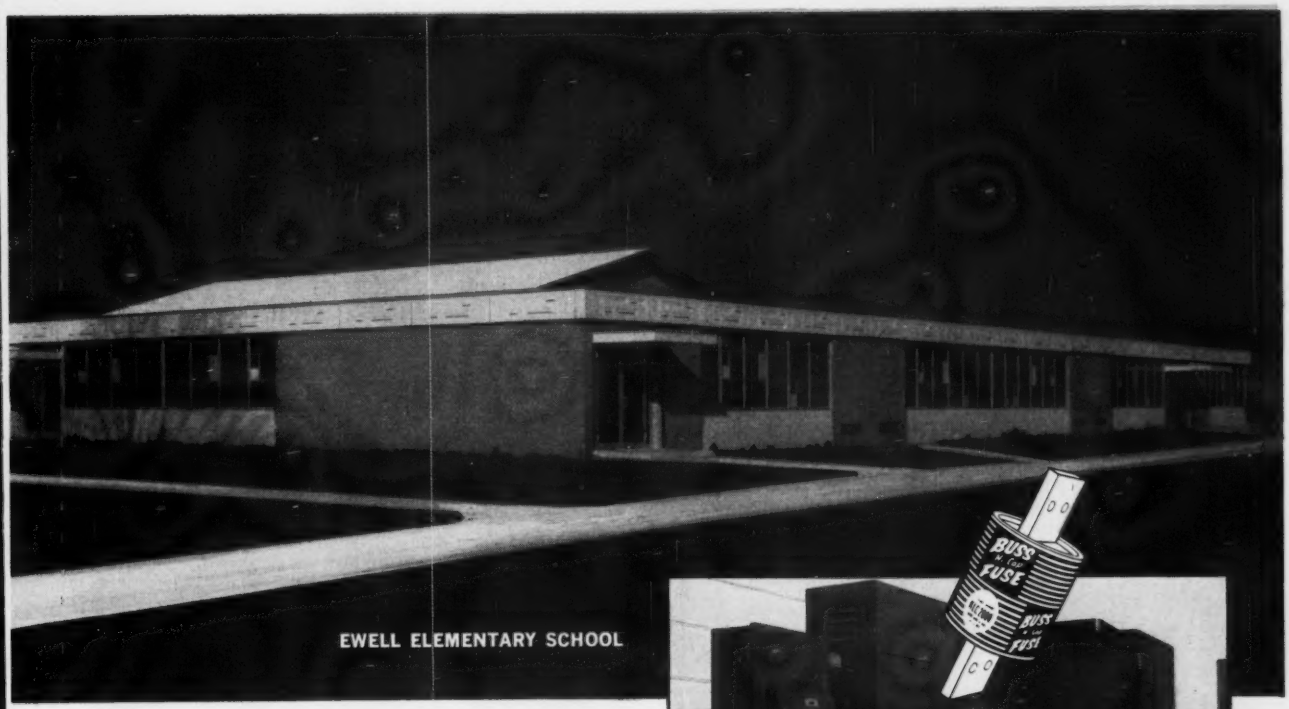


*For more information on*

**FUSETRON dual-element fuses** *. . . write for bulletin FIS*

**BUSS Hi-Cap fuses** *. . . write for bulletin HCS*

**BUSSMANN MFG. DIVISION,** *McGraw-Edison Co.* **St. Louis 7, Mo.**



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For more facts circle 824 on Reader Service card, p 197

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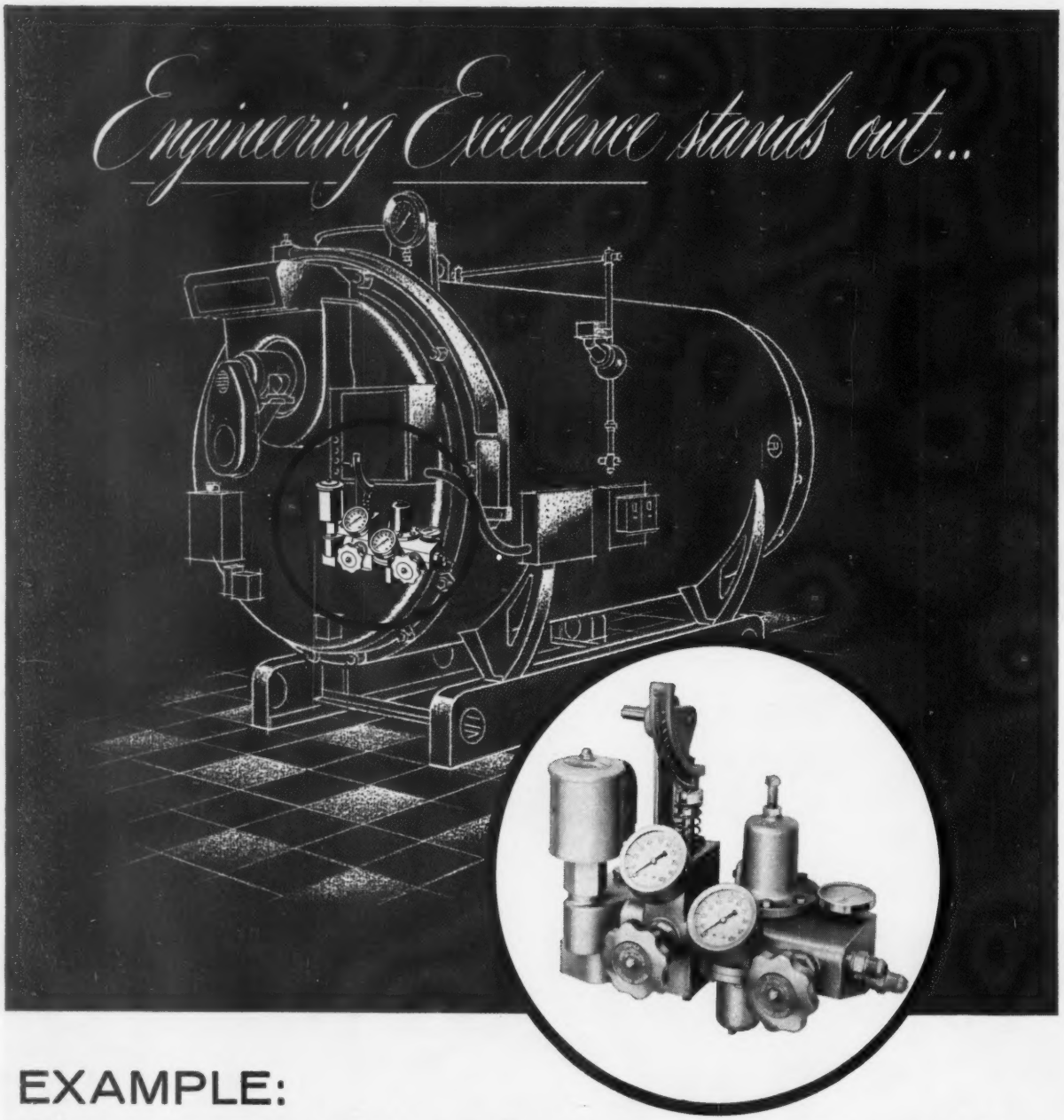

# EXAMPLE:
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1

**Power** reports on . . .

# Industrial Plant Design

**With a big defense program being piled atop one of the fastest business recoveries in history, industry is girding for even more growth. Following pages are packed with the design considerations energy-systems engineers will face in the months ahead**

**Noise control** is coming into its own: new building methods, a host of acoustical materials plus more fundamental know-how about noise and its effect on people. Use these ideas in the design stage. **p 68**

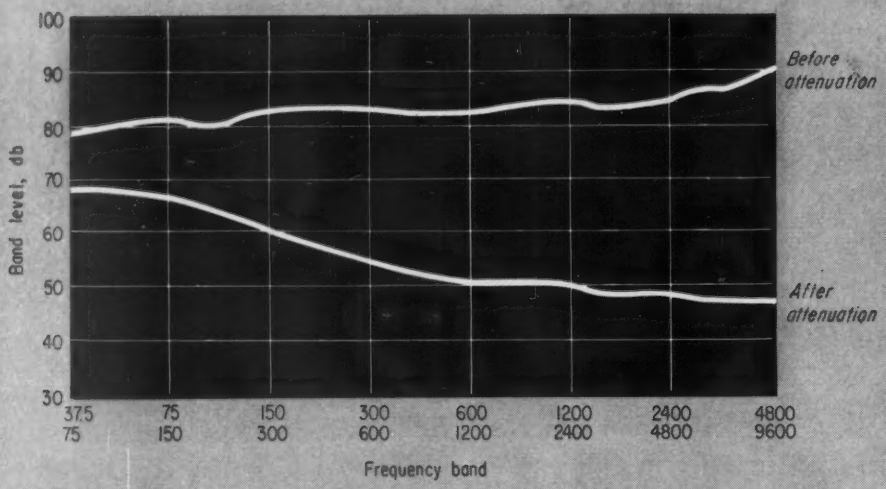
**Secondary unit subs** are not new—the idea of placing transformer-switchgear combinations close to load centers goes back 20 years or more. But unit-sub components are changing fast. **p 72**

**Lighting** imposes a greater load on air-conditioning systems as illumination levels climb. Many designers are trying an integrated system which drops cooling load while utilizing lighting heat. **p 77**

**Air-conditioning** control centers are proving out in field use—simplified operation, easier maintenance. Typical control center will log 100 or more remote points at rate of three a second. **p 79**

**Water-treatment** packaged systems are on the increase. Packaging can mean off-the-shelf equipment, standard designs using stock parts, factory-assembled skid-mounted pretested units. **p 82**

**Fire-resistant lubes** will see wider acceptance, and soon. Much of the lab work is over. Best guess is that first operating steam turbine-generator will carry a F-R lubricant by 1962. **p 84**




**BEFORE AND AFTER** noise-level readings show benefits of a carefully planned noise-attenuation program in an old building

# NOISE REDUCTION

## . . . what designers are doing about it and what you can do

**Today, management, designers and users take a greater interest than ever before in the auditory environment of industrial buildings. And with good reason. There are more noisemakers installed in modern buildings—every dynamic piece of mechanical equipment, in fact.** We know more about noise and its disturbing effects on people. We know how vibration can damage equipment. Noise control, too, is better understood than it was even one decade ago. Results: new building methods, wide use of acoustical materials, industrial and office machines designed to work quietly.

Did you know that insurance firms have numerous claims to pay yearly for loss of hearing? And they don't absorb the cost in the long run—*you* pay those claims as higher insurance rates. Excess noise also shows up on your maintenance bills, for noise is really destructive vibration energy which may ultimately fatigue and weaken your equipment and even building structures.

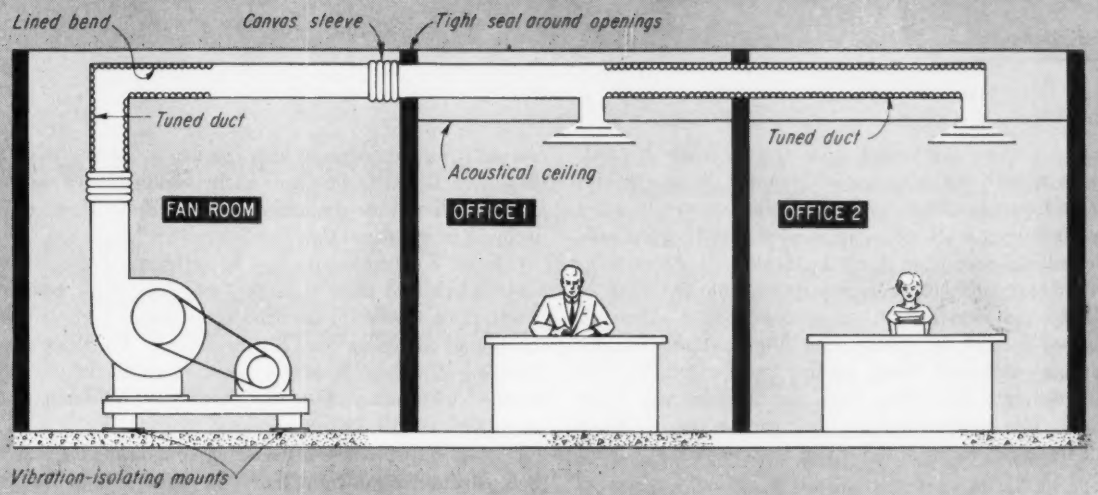
To get top-level thinking aimed at producing quieter industrial environments, POWER editors talked to leading acoustical engineers and architects about the country. And these experts all have one piece of advice to offer: *plan ahead!* Sound attenuation should go hand in hand with building design. Too often, the acoustical experts tell us, they are called in to solve irritating and costly headaches only after the building is complete and occupied. Almost invariably, then, it takes major surgery to remedy a problem that could have been prevented in the design stage at little or no extra cost.

In these four pages we cover today's thinking and practices on making sound behave. **We highlight problems** you should be looking for in the design stage, to get the greatest possible satisfaction from your new investment in plant equipment. But, should yours be the dilemma of quieting an existing building, we've pointed out how this, too, can be done—although perhaps with much more inconvenience and at considerably greater expense.

**Just what is noise?** We'd better define the problem before we try to fight it. Technically, a vibrating source will produce variations in air pressure, in terms of stress, particle displacement, particle velocity and so on. What we call air-borne sound is a variation from normal atmospheric pressure. Noise, which is *unwanted* sound, is really a whole mess of unrelated frequencies. Because of this, no single value can accurately describe a noise or its effects. Then—how *do* we measure noise? Here's what the American Standards Assn says: "No simple linear relations can be expected to hold between sound pressure level and time and acoustic energy. Nor is a single magic number, such as overall sound pressure level, apt to prove adequate to predict the effect of noise on hearing."

As we've said, most sound in air is produced by the vibration of a solid. Air that contacts this solid is set vibrating, and vibrations in air are relayed to the ear. Each vibration has a certain intensity, which we can measure in decibels (db). Intensity, in turn, produces sound power that can be measured in watts.

Table at right lists typical db levels for a variety of noises, starting at a boiler shop and growing progressively more quiet, finally reaching the hushed rustle of leaves outside your plant. These noises range in db from the point where intensity begins to cause the listener actual pain (threshold of pain), down to where the human ear cannot detect the noise at all (threshold of hearing).




**DUCT NOISES** carrying into all areas of a building can be prevented by isolating machine rooms and muffling the ducts

## These are noise levels you can expect

| Source | Decibels |
|---|---|
| Large chipping hammer, boiler shop | 130 to threshold of pain |
| Centrifugal ventilating fan (13,000 cfm), ball mill, drop hammer | 100 to 125 |
| Lathe, small electric fan, air drill, vane axial ventilating fan (1500 cfm) | 80 to 110 |
| Noisy office, average street noise, average radio | 60 to 80 |
| Quiet or average office, average conversation | 40 to 60 |
| Whisper at five ft, very quiet home | 20 to 40 |
| Rustle of leaves | 0 to threshold of hearing |

Frequency of a sound is the number of vibrational cycles that occur in one unit of time. The frequencies the human ear can hear run from about 20 to 16,000 cycles per second. Our auditory senses are much more sensitive to high-frequency than to low-frequency sounds. A 45-db noise of a high frequency may sound just as loud as a 60-db noise of low frequency. So sound level alone does not fully describe the auditory environment.

A given sound is likely to be made up of 10,000 or more frequencies, so we don't normally try to measure individual frequencies. Instead, for convenience in rating equipment and establishing specifications and codes, we separate sound into the eight octave bands shown in graph, above left. This octave-band measurement is the most practical indicator of the character of sound.

**How is noise transmitted?** You might be able to live with noise in one part of your building, *if* it would stay there. But sound is relayed from one room or space to another—walls and floors of a modern building may be the big problem. Too often the machinery room, housing air conditioners, elevator motors, boilers, pumps, etc, is placed in the penthouse—right next to the board room or perhaps the offices. This is going to create some real headaches. Before construction begins, check over your plans carefully, to see that board rooms and especially telephone switchboards are located well away from machinery rooms and other sources of noise.

Perhaps one of the biggest problems is ventilating ducts. They act as speaking tubes, carrying noise from one area to another. Conversations overheard from office to office or from one toilet room to another are likely to cause embarrassment, at the very least. Underfloor electric ducts, too, often carry noise from one office to another, perhaps as far as 100-ft away. Usually the troublemakers are low-tension ducts which have open fittings for telephone or signal wires.

Remedy for noise-transmitting ducts, again, should be preventive medicine—good initial design. But if you're already living with the problem, conversations, as well as the sound of fans and other equipment connected to ducts, can be deadened—although this may call for expensive sound isolators at numerous locations in the ducts, sketch above.

**Noise ratings** and vibration level for each machine are items of info the architect needs. How else can he design for noise attenuation? (The same holds good for you, if you want to attenuate an existing noise source.) So as soon as you've determined the type of new machinery going in, ask manufacturers for ratings. Some manufacturers supply this information on spec sheets; others can work it up if asked.

But if noise-level ratings are not available from manufacturers, solution might be checking similar equipment in another plant. One large chemical firm considerably

reduced noise in a new building, starting with this method. How accurately the readings will apply, of course, depends on how mountings, piping and duct connections the other plant uses stack up against what you've proposed. While taking readings, don't be fooled by extraneous vibration, carried back to the equipment you're trying to check through its foundation or connections. Measure cycles per second of vibration to filter out the foreign vibrations—vibration from another source will usually have a different frequency from the machine you want to check. The octave-band analyzer can be used to filter out all frequencies except those you're considering.

**Basic instrument** is the sound-level meter which measures the pressure level of the noise. It consists of a microphone, amplifier and indicating meter. Typical meter responds to sound-frequency components in the audible range between about 25 and 8000 cps. Sound-pressure level is indicated as a single number or range of numbers describing conditions over the whole frequency range.

With the proper sound-level ratings in your hands, your next step is to make these evaluations: (1) hearing-damage risks (2) speech interference (3) annoyance and (4) description of each noise source. Keep in mind that —all other things being equal—it is the high-intensity noises that cause hearing problems.

**Two major areas** to consider are *exterior* and *interior* producers of noise. Whether you like it or not, you'll have to do something about exterior noise. It may not bother you, but you'll be hearing from the neighbors if your new plant sends out weird noises continuously whenever it's in operation. Besides costly equipment relocation and changes in building structures, you might harvest a whole pack of messy lawsuits.

Start out by checking local codes. They may stipulate how to handle all internal noisemakers leading to the outside of your plant—then your option is taken away, and you merely have to consider how best to obey the law. But if the codes don't cover your case, make your own sound survey. First list all the outlets from ducts, exhaust vents, roof equipment such as mechanical-draft cooling towers. Then put down all potential noisemakers to be installed about the plant yards—transformers, dust collectors, individual machine buildings including power plants, pumping stations.

Right off the bat, take a good hard look at exhaust fans. They might flood the neighborhood with noise. Don't forget air intakes, either—any duct is a 2-way street, and noise travels, for practical purposes, just as fast in either direction in an air stream, regardless of air velocity. So you may have to muffle both openings: intake and exhaust of noisy high-speed fans, for example.

Cooling-tower fans can cause a big headache, especially if they're level with windows of adjacent buildings. At times, a noise barrier between tower and nearby buildings may help. In one case an acoustical engineer recommended that an extra fan blade be added to one of two cooling-tower fans. Here the two fans ran at the same rpm and had the same number of blades and similar blade characteristics. So their noise and vibration fit together and set up a troublesome beat frequency. After the extra blade was added to one fan, all its blades were respaced and the fan was dynamically balanced. Then noise dropped to an acceptable level.

Outside dust collectors can be quieted. If sheet-metal ducts leading to these collectors are long with complex bends, the larger solid particles traveling at high velocity make loud noises as they hit the sides of the duct when changing direction. Solution: damping material, usually fastened with adhesive to the outside of the ducts, does away with the tiny pinging sound.

Outside transformers often bring complaints because of their constant hum. Sometimes the answer is to build a cement-block barrier around this equipment. Your sound barrier should be twice the height of the transformers it hides. But modern transformers are usually designed to be quiet. If you check the noise level before buying a specific one, you may find you don't need a barrier. Incidentally, the vault around an inside transformer is usually sufficient isolation. Your only job is to make sure that the vault is sound-proofed.

Internal-combustion-engine exhaust seems to be particularly irritating. Unless properly muffled it can bring the entire neighborhood down upon your head. But exhaust and intake mufflers to do this job properly are available in many designs—again, as always, time to consider the proper one is now, in the planning stage.

**Interior noisemakers** can be doused, but first and most economical step is dividing the functions carried out inside your new building. Keep the noisy areas well away from the ones meant to be quiet. Second step: plan noise- and vibration-control measures to cut down transmission. This means: (1) isolating the vibration of mechanical equipment (see *Vibration Isolation*, a 16-p POWER special report, Aug 1960). (2) Enclose noisy areas and (3) use noise-reducing devices so noise doesn't leak through paths like piping, electric conduits and ventilation ducts. After the noisy equipment is all stashed away in the same area, you may still have to insulate some units individually.

Dynamic balancing may produce a marvelous improvement, if a machine has been running unbalanced. This might be your first step in stopping noise (see *Balancing Rotating Machinery*, a 24-p report, June 1959).

Locate your noisy machines as far as possible from windows that give onto your neighbors' buildings and will be opened. A new paper mill had its chief noisemaker —a big paper-making machine — alongside windows which were meant to stay open all the time. A long windowless wall 30-ft away could have been used just as easily. But they went ahead without proper forethought, the damage was done and lawsuits followed. As a result, the windows are now kept closed even during the dog days. The neighbors are happy, but the plant force complains—and loudly. Result: constant, rapid turnover of employees.

Suspended acoustical units for noisy areas are sound baffles hung within a room, either from the ceiling or structure or from a secondary suspension system such as stretched wires. They come in flat baffles, cones, prisms designed to deflect and absorb noise. Effectiveness depends a lot on expert spacing. Usually the sound absorb-

## Acoustical materials soak up noise

| Type | Material |
|---|---|
| I | Regularly perforated cellulose-fiber tile |
| II | Randomly perforated cellulose-fiber tile |
| III | Slotted cellulose-fiber tile |
| IV | Textured, fissured or simulated-fissured cellulose tile or board |
| V | Perforated mineral-fiber tile |
| VI | Fissured mineral-fiber tile |
| VII | Textured or smooth mineral-fiber tile |
| VIII | Membrane-faced mineral-fiber tile or board |
| IX | Perforated metal panels with mineral-fiber pads |
| X | Perforated asbestos-board panels with mineral-fiber pads |
| XI | Sound-absorbent duct lining |
| XII | Special acoustical panels and systems |

ers can be spaced so they don't interfere with fire sprinklers, lighting systems or air-handling units. As spacing between the absorbers increases, efficiency per unit goes up, but there is less total room absorption. So it's a delicate balance. Nevertheless, these units are popular because they're easy to hang and relatively inexpensive. Used right, they do an important job; they should go on your list of candidates to be considered for any noisy area.

**Acoustical materials** are basis of many soundproofing schemes, and the trend today is to give them more and more careful consideration. They can be any one of a number of architectural materials that absorb sound in enclosed spaces. A great variety of these materials are on today's market. The Acoustical Materials Assn, 335 E 45th St, New York 17, N. Y. has a valuable 54-p booklet, *Sound-absorption coefficients of architectural materials*, from which we've derived the above table of materials.

Once a sound is produced, it balloons out in all directions until it hits something—in a closed space, the walls. Some sound may be absorbed, depending on surface contacted, while the remainder bounces back to reverberate from other surfaces. So the more absorbent the material lining the walls, the less noise is left to be a nuisance.

A fine example of intelligent use of acoustical materials is the partially enclosed telephone booth used in subway systems. Three walls are lined with perforated acoustical materials while the fourth side is open. Even though subway trains rumble by a few feet away, the booth is quiet enough for a normal conversation. You can have similar good results in your new building. A lot of work has been done on acoustical materials and knowledgeable architects can be a big help with your design problems, selecting proper enclosure surfaces to absorb, reflect or transmit away the noise waves.

Materials shown in table above are all capable of absorbing a high percentage of the sound that strikes their surfaces. Lower limit of absorbing quality for these materials runs about 20%. By contrast, the usual building materials of concrete, plaster and glass absorb from 1 to 10%. Worse still, if these surfaces are glazed, the sound may bounce from surface to surface for several seconds.

Besides walls proper, materials can be used to line total enclosures or for partial enclosures such as air ducts. Which linings you'll pick for attenuation of ducts, for example, depends on (1) length of duct (2) thickness of lining (3) flow resistance of lining (4) width of air passage and (5) wave-length of sound.

Acoustical plaster consists of an aggregate of vermiculite or perlite with either a setting type of binder such as gypsum or lime, or a nonsetting type. Plasters are applied to a scratch or brown-coat plaster base, or directly to a concrete or masonry structure. But make sure to have a hard backup surface of some sort. One way to increase surface porosity is to wirebrush or roller-stipple the surface, and this also helps retain porosity after painting.

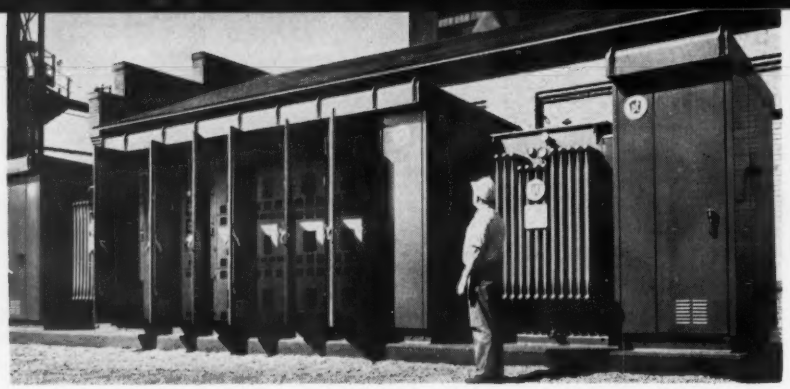
**Here are some construction tips** passed on by the experts: if your building is near railroad tracks, be sure to insulate the column bases against vibration which will carry up through the building structure. Lead-encased asbestos slabs are a good answer. To keep noisy machines on top floors from causing special problems, the floor can be made of a 6-in. slab of reinforced concrete, covered with 1 or 1½ in. of high-density fiberglass. These layers serve to keep out noise, and heat and moisture as well. They're next covered with 2 in. or so of cement floor.

Double-wall construction can greatly reduce noise transmission. Two walls, structurally isolated and separated by an air space, kill noise much more effectively than a single wall, even though the single wall has the total weight of two walls. Double walls mount on separate footings. If they cannot be so mounted, cork pads, resiliently joined to vertical columns or overhead beams without ridged ties, can be used.

Doors are always a problem when you're trying to keep high-intensity air-borne noises in or out. Where noise runs 40 to 50 db, sound-reduction doors with specially engineered sills and jams are installed—these can be single or double doors.

Sound-absorbing treatment of walls and ceilings is common. But if a solid such as a thin partition is the transmitter, noise difference before and after acoustical treatment may be barely measurable. Usually a 7- to 10-db noise reduction is the maximum that treated walls and ceilings can achieve. Where overhead pipe, ducting or girders make ceiling coverings impractical, the hanging baffles we discussed before often get similar results.

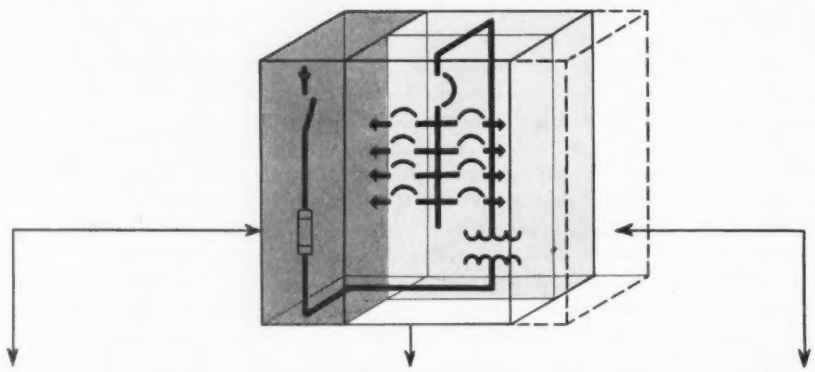
**Does all this sound complicated?** Well, there's no doubt that it *is*. For any sizable project, best bet is to call in an acoustical engineer before plans get too far along. We've tried, in these four pages, to cover highlights of noise reduction in modern and older buildings, to show why you should give serious consideration to this subject of noise. For more specific information, POWER plans a special editorial report on *Noise Isolation;* look for it early next year.



# SECONDARY UNIT SUBSTATIONS
## . . . supply loads safely, conveniently, flexibly

**Placed close to load centers, they take primary distribution voltage and transform it to voltages below 600. There are usually three main sections in a secondary unit sub: incoming protection, transformation, low-voltage protection,** and you have your choice of apparatus in each section. The three basic unit types are *panelboard center, single-ended substation* and *double-ended substation.* Among other reasons why unit substations may be preferred: space saving, easy installation, prompt delivery, lower first cost.

### Panelboard centers: power and lighting to 500 kva



**Incoming section**

is rated up to 5 kv. Terminals are clamp type solderless connectors, eliminating potheads. Fused air load-interrupter switch is usual, but the switch may be unfused. Or you can get oil-filled fused cutouts, or centers with no disconnect or protection. Tap-changing panel is readily accessible, separated from incoming and outgoing lines. Lightning arresters are recommended; some manufacturers supply them as standard, consider them necessary with dry type transformers. If unit has 480-v primaries you can get a circuit breaker to serve as disconnect and protection for entire unit. This may be a single breaker or part of a panelboard with other 480-v breakers used on external feeder circuits to different locations.

**Transformer section**

Panelboard center generally uses dry type transformer with open air-ventilated construction. Insulated for Class H operation—glass fiber and silicone varnish—they are rated 150 C. Conventional cores are used, and square coils to keep space to minimum. For each primary voltage—2400, 4160, 4800 v—you can get a transformer with one of these secondary voltages: 208Y/120, 480Y/277, 240 and 480 v. Primaries have two taps, 2½% above and below normal. Transformer section is behind low-voltage section; incoming section is normally on the left but you can get it on the right. Optional metering section provides additional panelboard space if needed. Some models have l-v section facing right instead of at front.

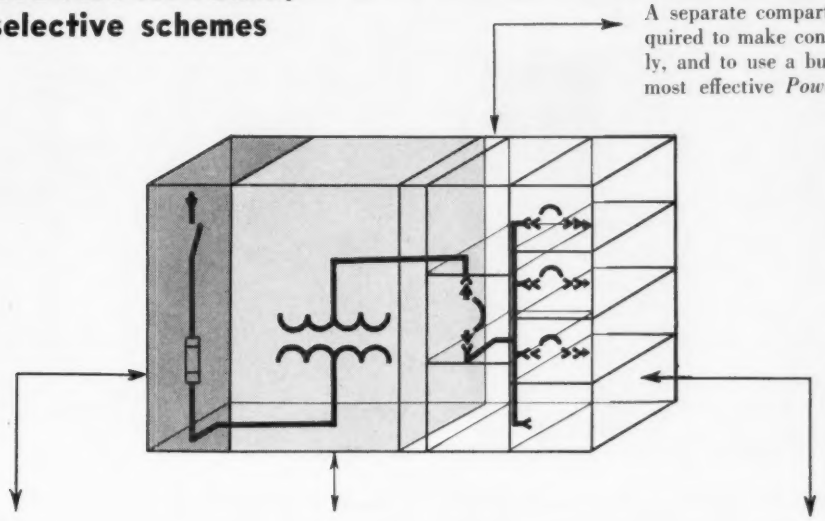
**Low-voltage section**

This usually consists of a panelboard with molded-case circuit breakers in either *convertible-power-panelboard* or *lighting-panelboard* arrangement. Convertible panelboard uses heavy-duty distribution breakers which you can rearrange as feeders are added or changed to meet load growth. Panelboards can include main and branch circuit breakers or branch breakers only. Breakers are available from 15- through 1000-amp continuous rating. At least one manufacturer offers combinations with motor starters. Lighting panelboards cost less, but they're limited to 50-amp full load and 5000-amp interrupting capacity on each branch circuit. Instead of molded-case-breaker panelboards, you can get fused switches

## Single-ended subs for radial, primary-selective schemes

### Transition section

A separate compartment is usually required to make connections conveniently, and to use a bus arrangement with most effective *Power-to-Grow* features.



### Incoming section

Metalclad air-magnetic circuit breakers may be used for maximum protection, but more commonly the incoming section contains a fused load-interrupter switch. Unfused switch or simple air-filled terminal chamber is available, and so are roof bushings. Transfer switches for primary selective systems may be in a single compartment, but some manufacturers prefer separate (but interlocked) switch compartments. Where transformer is insulated with a liquid—oil or askarel—you can get liquid-insulated incoming section: a disconnect switch, a load-interrupter switch or switchless terminal chamber. Some manufacturers offer further choice of oil cutout (fused or unfused) with any transformer. Cutouts mount in a metal-enclosed compartment.

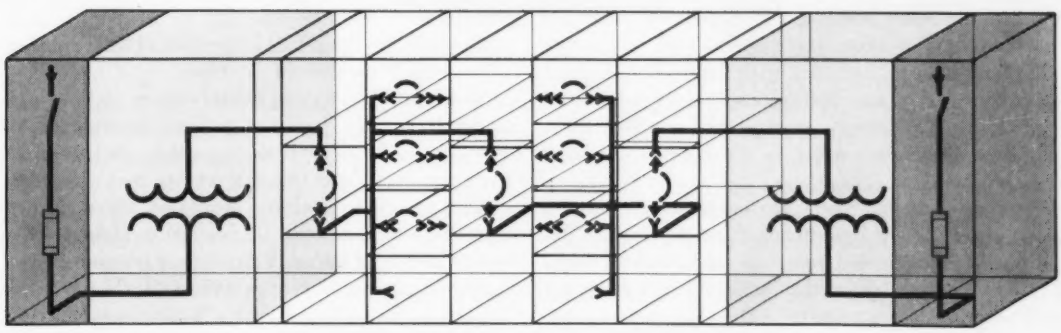
### Transformer section

Oil- or askarel-insulated transformers or sealed or ventilated dry types are available. Sizes generally range from 300 to 2000 kva, with 1500 kva popular. At least one manufacturer has a range from 112.5 through 3000 kva. High-side voltages are 2.4, 4.16, 4.8, 6.9, 7.2, 12, 13.2 and 13.8 kv. Secondary voltages: 208Y/120, 240, 480, 480Y/277 and 600 v. In the case of liquid-filled transformers, the incoming section may not be a separate compartment, but instead a switch housing or other enclosure mounted directly on the side of the transformer. In other cases units may come with a transition compartment or a throat between incoming section and transformer. Duct may also be used if for some reason you want to separate the incoming from transformer section.

### Low-voltage section

All manufacturers offer metalclad l-v power (air-magnetic) circuit breakers. Typical arrangement has one main breaker and a number of feeder breakers, although main breakers may be omitted in some designs. Spare compartments are usually provided for both main and feeder breakers to take care of system expansion. Some manufacturers offer a panelboard arrangement of molded-case circuit breakers, essentially the same as the panelboard units on previous page, through the full 2000-kva range. Circuit breakers backed up with current-limiting fuses are available and they're gaining popularity. Another manufacturer has an electrically operated load-break switch in combination with current-limiting fuses. It's rated to 800-amp continuous.

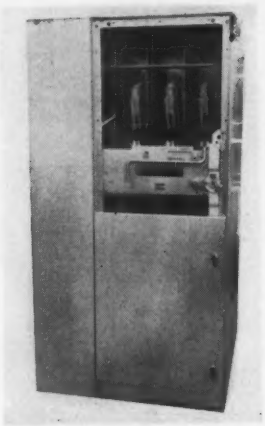
## Double-ended subs handle secondary selective, network schemes



### L-v tie-breaker section

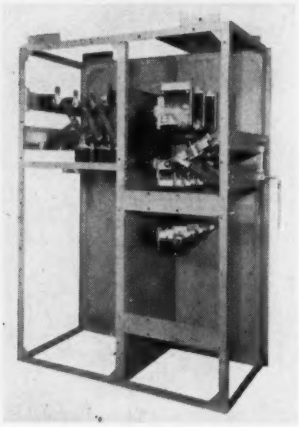
Two unit subs, reversed section for section, are connected through a section with a tie circuit breaker. Ties are normally open for secondary selective schemes, normally closed for network. Systems may be combined with primary selectivity.

## For incoming section you have a wide choice of . . .



**Fused or unfused load-interrupter switch**

Among different manufacturers, air-insulated load-interrupter switches may vary considerably in detail, but main features are similar. Contacts open and close the circuit in air. Switch is generally 3-pole 2-position type, manually operated from side or front of the compartment and interlocked with the door. Contacts are closed through a stored-energy mechanism; they're designed to withstand closing in on system's maximum fault current and holding the switch closed. A typical rating for 5-kv class: continuous (and interrupting), 600 amp; close and latch, 40,000-amp-rms asymmetrical; momentary fused, 60,000-amp-rms asymmetrical; momentary unfused, 40,000-amp-rms asymmetrical. Line connections to switch blades are made through porcelain bushings; cable terminations can be made in air or potheads.



**Transfer switches**

Switches to select primary circuits are supplied in different forms. Typical arrangement is an air load-interrupter switch mechanically interlocked with no-load selector switch in a different compartment. Another setup uses two mechanically interlocked load-break switches. Some manufacturers have a pneumatically operated load-break switch—most widely applied in automatic-throwover schemes. One standard automatic-throwover arrangement uses potential transformers on the line side of the preferred-source switch for sensing voltage loss. Other pt's are used on the line side of the stand-by-source switch for control power. Either source can be selected as preferred, manual or other functions—determined by the control panel for the pneumatic operator. Compressed air comes from tank in compartment.

## Transformers match full range of indoor and outdoor operation

Oil- or askarel-filled transformers are used indoors or outdoors, cooled by radiators. Two types of coils are in use: (1) Continuous-wound pancake coils are made up of a column or stack of disk sections separated by horizontal oil ducts. The conductor consists of a number of rectangular straps in parallel, wound continuously over vertical pressboard strips on a pressboard cylinder. This design is usual in units below 300 kva. (2) Standard cylindrical windings have one or more layers of insulated conductors on a heavy insulating cylinder with liquid-impregnated pressboard insulation and vertical cooling ducts between adjacent layers. This design is especially good at withstanding high mechanical stress, so it's common for larger units.

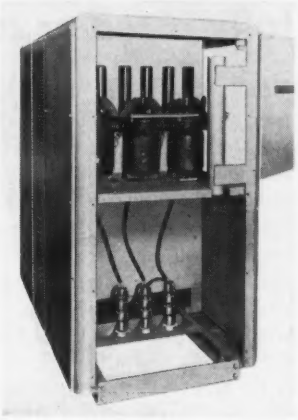
Oil or askarel transformers are recommended where overvoltages are likely because of their higher-BIL design. Ruggedly constructed tanks are designed to withstand full vacuum and operating pressure. Self-reclosing and self-resetting pressure-relief valves are customary, although some transformers use a nonresetting diaphragm relief device instead. Manufacturer usually supplies indicators for liquid level, liquid temperature and gas-space pressure. Some units feature reversible accessories, so that a standard unit converts to a reverse unit for a double-ended arrangement. Tank covers are welded on some units, bolted on others. No-load gang-operated tap changer's insulated drive shaft extends through the tank wall.

Typical impedance values: from 5.0% for 300-kva units to 5.75% for 2000-kva units. Today's substation transformers are designed for quiet operation. In general, available liquid-filled transformers have a somewhat lower noise level than the dry types.

**Ventilated dry type transformer** (typical unit, center photo at right, is shown with covers removed) is normally cooled by convection of air through louvers of compartment cover and through transformer windings. You should use them in clean, ventilated areas inside buildings, usually near the load—they are relatively lightweight and fit in line with switchgear compartments.

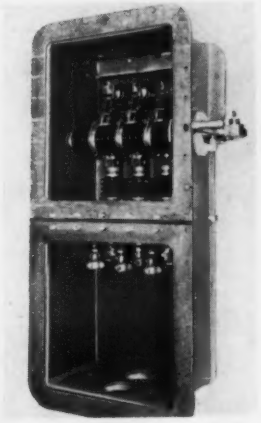
Forced-air-cooled ratings are available on units rated 750-kva self-cooled and above. When fans and associated controls are added, the transformer has a supplemental rating of 133% of self-cooled. Some makers of 750-kva or larger transformers regularly provide for later addition of forced-air equipment.

## . . . terminals, disconnects and circuit protective devices



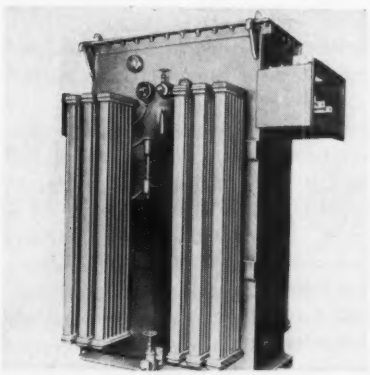
**Oil-filled cutouts**

Gang-operated oil-filled cutouts are mounted in a metal-enclosed compartment. Use them with either indoor or outdoor substations—they're suitable for both. With outdoor units, cutouts can mount in a small compartment attached to the side of the transformer tank instead of occupying a compartment of full height and width. Cutouts can be supplied with fuses or with solid links; in either case they can interrupt full-load current of the transformer. Each manufacturer sets his own limits on kv and kva ratings he's willing to supply cutouts for, and not all unit-sub makers offer them at all. One manufacturer has fused cutouts at 2.4 kv and 750 kva; 4.16 kv and 1000 kva; 4.8 kv and 1500 kva; 7.2 kv and 750 kva. Fuse-link ratings (rms-asymmetrical amp) range from 11,000 (2.4, 4.16 kv) to 3759 (6.9, 7.2 kv).

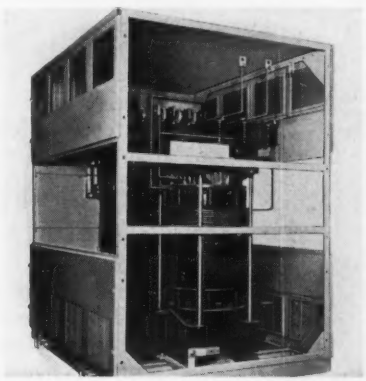


**Liquid-filled switches, terminal chambers**

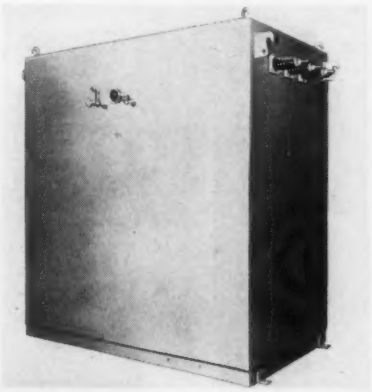
Liquid-filled switches can be provided on all immersed transformers; switch compartment is welded or bolted to side of transformer tank and equipped with potheads. A 3-pole 2-position switch is normal, but you can get them in 3-position models. Oil-filled switches interrupt load current. Askarel-filled switches are suited only to break magnetizing current of specified amperage and for a certain number of operations before you'll need to replace the askarel. Where switches aren't needed, liquid-filled terminal chambers are available on all immersed transformers—liquid is same as in transformer. Filled terminal chambers are most compact incoming section. Potheads are always used; they may have single or multiple conductors. Liquid-tight bushings extend through the transformer-tank wall into terminal chamber.



**Liquid immersed**



**Dry ventilated**



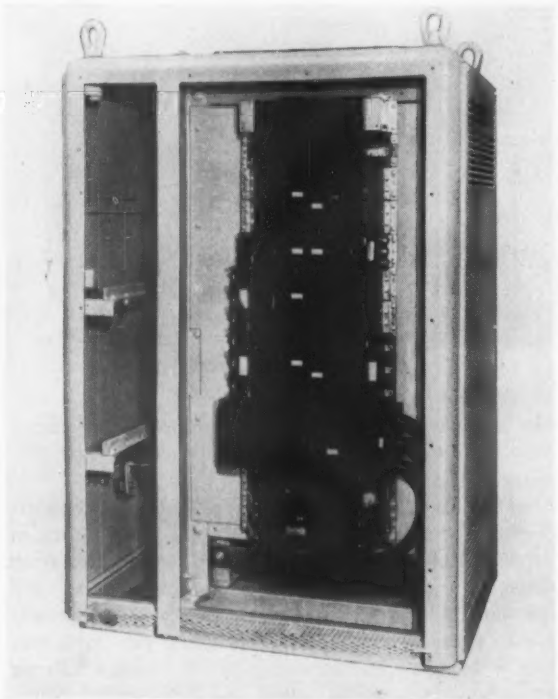
**Dry sealed**

You have your choice of Class B (80-C rise) or Class H (150-C rise) insulation systems across the full range of substation sizes with ventilated dry type transformers, as listed by some manufacturers. Other makers standardize on Class-H insulation but rate case temperatures well below Underwriters Standards maximum—about the same as for their previous 80-C-rise units. They claim their silicone insulation offers greater resistance to heat deterioration, provides a greater margin of safety for overloads.

In general, two coil types are used. Units below 500 kva come with a compact, rectangular coil. On other units the low-voltage coils are cylindrical while the high-voltage coils are the continuous-wound pancake type, above. Coils are wound over cooling ducts mounted on fire-resistant insulating cylinders.

**Sealed dry type transformers** handle service indoors and out, where they stand up to dusty, dirty or corrosive atmospheres. Rated 300 kva and up, they boast inherent fire resistance and need minimum maintenance. Enclosure is a welded-steel tank or case, hermetically sealed. Nitrogen is usually the insulating gas, but newer gases with higher dielectric strength are coming into the picture (see POWER, Sept 1961, pp 80-82). Solid insulation is inorganic, such as porcelain, mica and glass fiber, in combination with silicones or a similar binder.

**L-V POWER CIRCUIT BREAKERS** are designed for maximum ease of handling. You can readily attach special hoist to compartment



**MOLDED-CASE CIRCUIT-BREAKER** panelboards are available in range from 45 through 2000 kva, both indoor and outdoor

## Low-voltage section: your choice of selective, fully rated or cascade

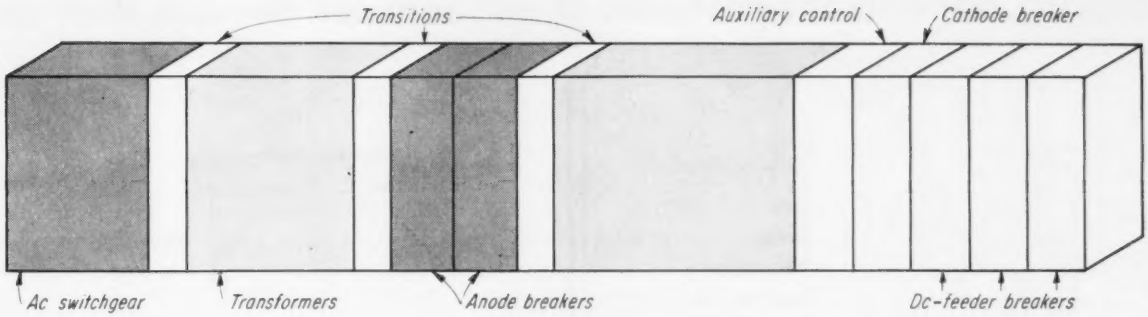
Metalclad l-v power circuit breakers are a highly developed product, and one that is almost completely standardized. Breakers are all draw-out type, with the breaker itself located at front of the compartment, bus arrangements at the rear. Bus is generally silver-plated aluminum, but may be copper. Pressure contacts connect breaker to bus, and so the breaker is automatically disconnected when withdrawn. Terminal blocks for the control circuit, located in bus compartment, are readily accessible. Main breaker is normally located in center of a 3-high stack, with an instrument panel above and a spare compartment or tie breaker below. Usually an indicating ammeter and voltmeter, with transfer switches, and a watthour meter are included. Feeder breakers can be supplied with instruments if you want them, and other arrangements such as pf meters, wattmeters, recording instruments and test blocks for portable equipment are standard accessories.

**Feeder breakers** up to 600 amp normally stack 4-high. Recent breaker-frame uprating will permit higher continuous-current ratings for these compartments in some designs. The outdoor unit is essentially indoor l-v gear set in a weatherproof enclosure. You can get to outdoor equipment from either front or rear—an enclosed work aisle, which is usually included, allows enough space for a breaker to be left withdrawn with the enclosure door shut.

Interlocks and positioning devices assure safe removal and replacement of breakers, and the door interlock prevents access to the closed breaker. Breakers move (horizontal travel) from *connected* position to *test* and *disconnected*, or you can remove them completely for maintenance or replacement.

**Interrupting ratings** in rms-asymmetrical amp range from 15,000 (15-amp continuous, 600 v) to 150,000 (4000-amp continuous, 240 v). Today's breakers feature "stored-energy" closing: the actual closing is done by a powerful spring which is charged either manually (this is customary) or with a small electric motor. You're sure of quick closing, and the mechanism is powerful enough to close against a full short circuit equal to breaker's interrupting rating. Overcurrent-trip devices have series coils and operate on magnetic principle. Three basic characteristics—*long-time-delay*, *short-time-delay* and *instantaneous*—can be used in various combinations for different applications. In a typical device, long-time-delay is handled by a sealed-oil (silicone) dashpot; short-time-delay by a mechanical escapement.

**Current-limiting fuses** may be used in l-v drawout switchgear. One manufacturer uses them to back up air-magnetic breakers and extend their application to circuits with 200,000-amp available short-circuit current. Another manufacturer uses c-l fuses together with a load-interrupter switch built along circuit-breaker lines—switch operates electrically. Fuses are available with 800-amp-continuous rating, 100,000-amp interrupting capacity. Their current-limiting action can save you money over use of circuit breakers of same continuous-current rating.




## Applications are growing for dc unit subs

Lineup of connected metal enclosures shown above houses a complete dc unit substation, factory designed and tested so you only need to make the bus connections to assemble the unit and then connect it into your system. Ac switchgear, transformers (which may be liquid or dry), anode breakers, rectifiers (either mercury-arc or silicon-diode), auxiliary control, cathode breaker (main dc breaker) and dc feeder breakers make up the major sections—transition sections come in between. Modifications in type of package let you install it to fit site requirements: all-inside, all-outside or split with rectifier, controls and dc switchgear inside, ac switchgear and transformers in a substation outside the building.

**Pumpless ignitrons** in the mercury-arc units are water-cooled, requiring a few simple plumbing connections (for details on rectifiers see POWER's special report on *Electrical Conversion*, Dec 1959). Silicon-rectifier units are cooled in one of three ways: (1) direct air cooling forces air over cell's cooling fins (2) direct water cooling circulates water through hollow bus (3) indirect air cooling in sealed units circulates air over cells' fins and through an air-to-water heat exchanger.

Overall efficiency of complete unit from ac input to dc output is high (it depends to some extent on the dc voltage). For a 600-v silicon unit, efficiency will be over 97%. Typical power factor is about 95% lagging.

# INDUSTRIAL LIGHTING

## ...trend is to greater illumination, calling for integrated lighting-air-conditioning systems

**Need for increased quantities of light is generally accepted by industry. But electric light generates heat in proportion to wattage. Higher lighting levels mean more heat must be removed during cooling season to keep occupants comfortable.** In an office building with 100 ft-candles of general illumination, lighting accounts for about 37% of the air-conditioning cooling load. When lighting level increases to 400 ft-candles the resulting heat takes up more than 70% of the total cooling load.

**Conventional air-conditioning** approach for high-level lighting can be very costly. The designer simply adds more cooling capacity, increases amount of air moved through the space or lowers temperature of input air. Integrating the lighting and a-c systems is a new technique that promises much better overall economy.

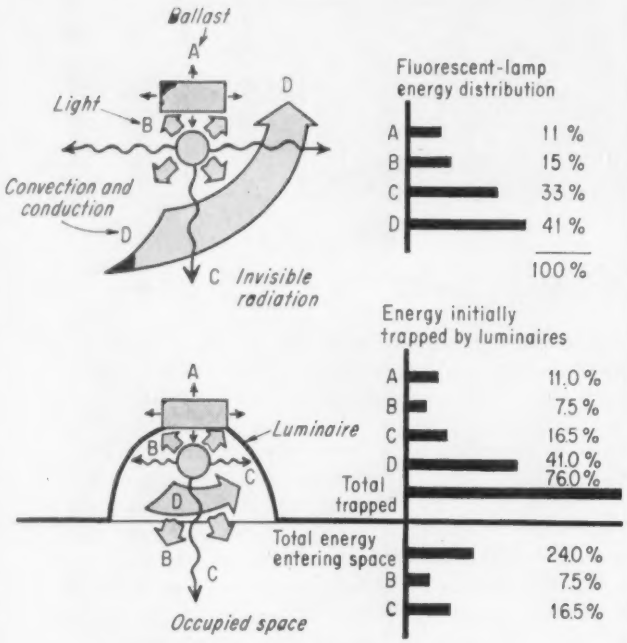
**Study of heat characteristics** of a fluorescent-lighting system reveals that about 76% of total heat produced by a 40-watt lamp and ballast is initially trapped in a troffer. Similar analyses can be made to get percent of heat for any luminaire. Amount is significant for all.

Lighting heat can be removed easily by pulling exhaust air out of the space through the lighting system. This air discharges to atmosphere and is replaced by cooler makeup air, or if exhaust-air temperature is lower than outdoor air it can be recirculated through the cooling system. In cold weather the air circulates as before, but warm air discharged from the lighting system is returned to the space to handle part or all of heating load.

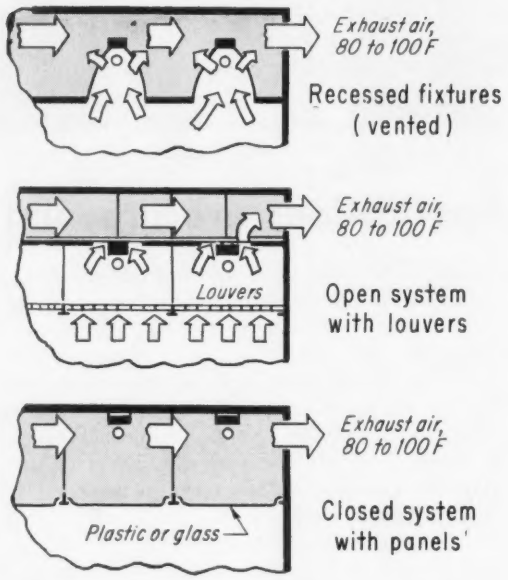
Integrated approach accurately controls the effect of lighting on cooling and heating. Cooling load may well be less for an integrated system with high illumination standards than for a conventional system with much poorer lighting—control of lighting heat entering occupied space makes the difference. Lamp ventilation obtained also makes it practical to use lamps of greater loading, reducing initial cost of lighting system and greatly lowering overall lighting costs.

continued

# Higher lighting levels make it economical to consider an




**Heat output** of lighting system is prime factor in plant design. Energy output for a 40-watt fluorescent lamp and ballast diagramed above shows that only 15% of lamp-ballast wattage gives useful light. Remaining 85% is dissipated. Luminaire with 50% efficiency absorbs half the light and invisible radiation. So 76% of total heat produced is trapped. If not removed it travels by convection-conduction or re-radiation to adjacent ceiling and eventually enters room.


Exhaust air, 80 to 100 F
Recessed fixtures (vented)
Exhaust air, 80 to 100 F
Louvers
Open system with louvers
Exhaust air, 80 to 100 F
Plastic or glass
Closed system with panels

**Heat removal** can be handled by passing air through the luminaire. Exhaust air pulled out of space through lighting system will carry most of lighting heat away before it affects room comfort. Sketches show this heat removal from three types of lighting and ceiling construction. It's also possible to remove heat by circulating water through the luminaire or the ceiling structure itself. Preventing uncontrolled heat buildup helps achieve maximum operating efficiency.

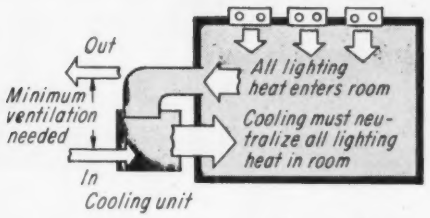
**Practical applications** of integrated systems are reported in detail by W S Fisher and J E Flynn in their paper, "Integrated lighting-air-conditioning systems," presented at Illuminating Engineering Society's 1959 National Technical Conference. Sketches above are based on ideas developed and explored by Fisher and Flynn, in their work at Nela Park. But, at present, only one luminaire of the type they used in their tests is available for integrated systems.

Headquarters building of Rochester Gas & Electric Corp in Rochester, N.Y. is an outstanding example of a newly integrated lighting-air-conditioning system (see June POWER, p 96, *Building relights at 200 ft-candles*). Heat produced by this lighting system provides nearly all the heat needed for winter operation. During warm months, lighting heat exhausts to atmosphere to reduce load on the air-conditioning system. Improved lighting will increase employee efficiency by paving the way for faster, easier and more accurate seeing. They expect that less than a 1% improvement in worker efficiency will offset increased owning and operating costs for this newly integrated lighting, heating and air-conditioning system.

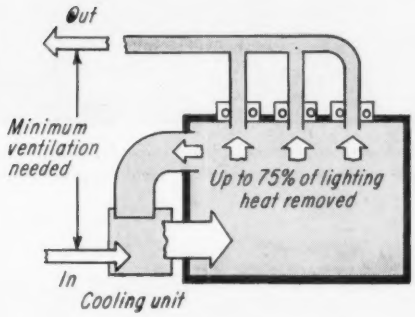
Higher lighting levels will definitely change the economic analysis in many heating and cooling systems. For example, heat-pump size is usually fixed by winter heating load. In summer, maximum temperature differential needed is 15 to 20 F. Winter conditions call for 70- to 75-F gradients. Since the same equipment handles both heating and cooling it must be sized for the larger winter load. But if a supplementary heat source is available the economic picture changes. Size of the required heat pump is greatly reduced, and on this basis a controlled supply of heat from high-level lighting systems may make the heat-pump installation most economical.

As the demand for higher lighting level increases, cost advantages of integrated lighting-air-conditioning systems for both winter and summer operation will become more attractive to industry. In warm weather, reduced lighting heat improves occupant comfort, cuts air-distribution needs and cooling load. In winter, controlled distribution of heat greatly improves heating-system economy. In addition, near-optimum lamp and ballast temperature conditions for most efficient operation are always maintained, so lighting system retains design lighting levels.

## integrated system to drop cooling load, use lighting heat

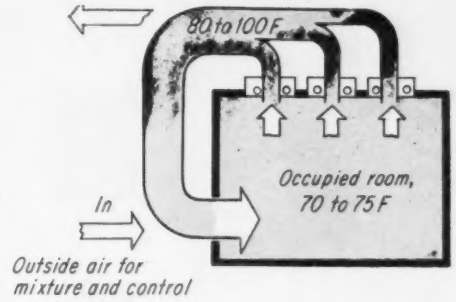


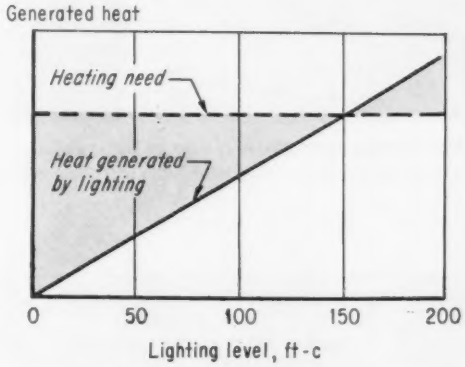

Conventional cooling system




Integrated cooling system

**Integrated system** of lighting-air-conditioning reduces cooling load by drawing off up to 75% of lighting heat before it enters room. This is done by sending exhaust air through luminaires with remainder recycled to cooling unit through general room exhaust. Conventional air-conditioning system, by comparison, must handle all lighting heat in room. Air removed through luminaires discharges outside in warm weather. During winter it can be recirculated for heating.




**Amount of lighting heat** available varies with lighting level, light source, system efficiency and building design. Graph above, based on heat needs of a 20-story office building, shows that lighting level of 150 ft-c generates enough heat to meet building heat loss with outdoor temperature of 0 F, 15-mph wind. As lighting levels increase, the potential value of lighting heat becomes an important factor in improving the overall economy of an integrated system.

# AIR CONDITIONING ...control centers simplify operation, take on auxiliary jobs as well

**Trend to centralized control of air-conditioning systems started over ten years ago. Now complex control centers run an entire building almost single-handedly.** Air conditioning is the treatment of air to control simultaneously (1) temperature (2) humidity (3) cleanliness and (4) air distribution. Therefore controls are actually the heart and brains of every such system.

Aim of a control center: bring all air-conditioning data and required controls to one spot so equipment for the entire building or plant can be handled most conveniently. First problem is determining how much supervision and control is needed—operating data can be centralized with vastly different degrees of completeness. Every installation warrents some centralization, even if it's only a collection of indicators to show space temperatures. Larger, complex systems easily justify more complete data centralization—zone temperatures, dew point for each fan system, temperatures of return air, fan discharge, chilled water and so on. Because there are so many variables, each control center is custom-designed to meet individual needs of its building or plant.

**Early control centers** resemble process-control panels. Each part of the a-c system is displayed graphically on a panel which may stretch out 20 to 30 ft. Indicating dials, pushbuttons, equipment are located on the schematic drawings in positions corresponding to their actual place in the cycle. Operator quickly checks temperatures, pressures, flows at a given spot in the system and makes adjustments right at his console without visiting each area.

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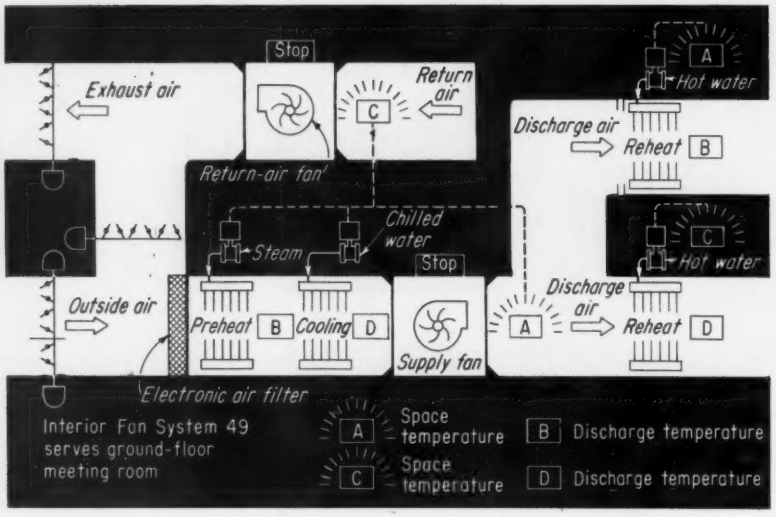



**CONTROL-CENTER OPERATOR** at new Chase Manhattan building uses pushbuttons to view any of 37 different schematic drawings of air-handling systems supplying first 21 floors. Typical drawing shows hookup, indicates where temperatures are measured

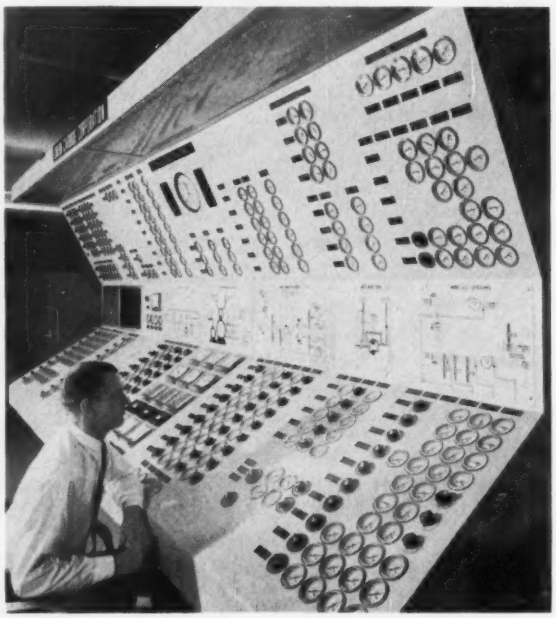
## Two centers handle a-c system at 64-story Chase Manhattan building

**Recent designs** considerably reduce physical size of the center by putting the schematic drawings on 35-mm slides. These are projected onto a translucent screen about the size of a home television receiver. The operator pushes buttons and whatever schematic he wants comes on the screen right in front of him, while control circuits for data indication and adjustment are locked in at the same time. When the slide is changed the control circuits automatically switch. Each system can have a variety of controls for fans, motors, pumps, temperature, humidity, so one set of pushbuttons controls as many as 50 individual parts of the system or other functions.

**Centralized control helps bridge the gap** between increasingly complex plant energy systems and the shortage and high cost of properly trained operating and maintenance people. Modern control centers give the operator a sense of pride in his work, help him become thoroughly familiar with the system. Day-to-day operation is simpler, so closer supervision of results is possible. The operator can focus all his attention on one part of the system at a time. One man at a well-designed control center can do a more effective job than a whole staff—no matter how competent—using older trial-and-error methods.

**Chase Manhattan building,** recently opened, towers 64 stories high; its 9400 tons of cooling capacity would be enough to melt a 20-story-high block of ice every day. The 4-zone interior air conditioning on each floor is supplemented by a perimeter arrangement. Interior zones receive medium-velocity-pressure air, and for each zone on every floor, temperature is individually controlled. 18 perimeter systems circulate high-pressure high-velocity air through induction units where it mixes with room return air in the ratio of 1:5. Low-pressure air circulates through ceiling diffusers on the basement levels.

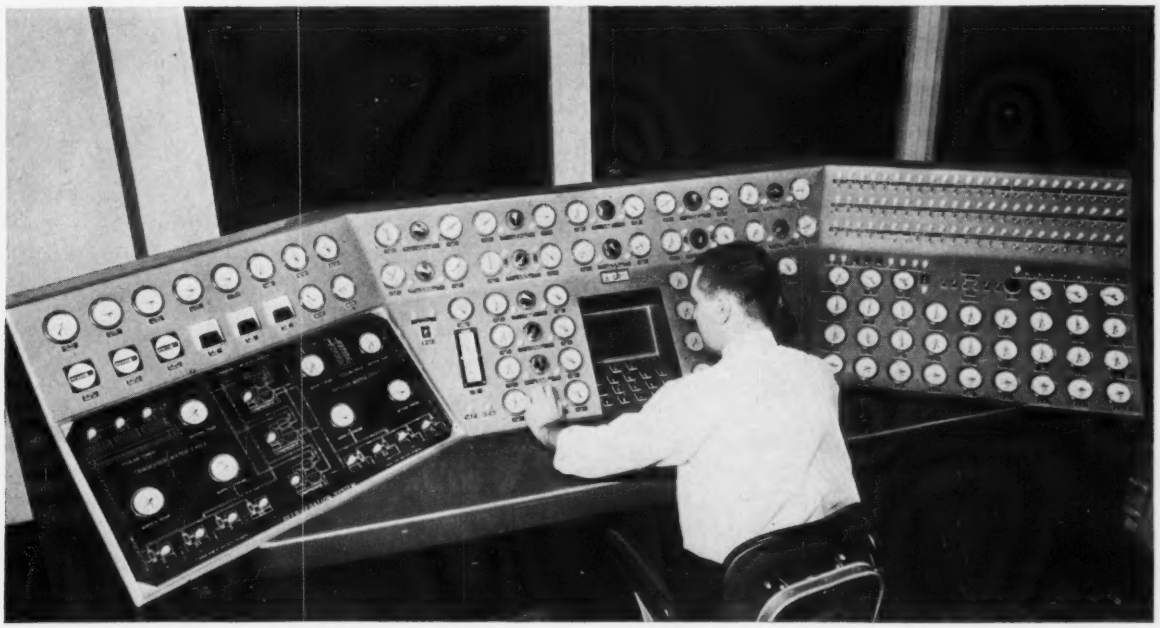
Circulating water through induction coils is at 90 to 110 F during winter, in summer about 60 F. Thermostats sense return-air temperature, regulate water flow to maintain a constant temperature. All air passes through electronic cleaners.



**SCHEMATIC DIAGRAMS** are prominently featured on control center at Union Carbide building—pushbutton slide viewer at left

Two control centers are brains of the system. One on the 11th floor handles the first 21 stories plus basement; other on 31st floor takes care of upper floors. Lower center has at least 14 major functions—simply by pushing buttons the operator can, among other things: (1) view any of 37 different schematics of air-handling systems (2) view

**DATA LOGGER** and scanner is vital part of many new control centers. This installation, at a hospital, automatically logs data from 100 remote points in system at rate of 3-digit bits of info a second. Continuous scanner warns if reading exceeds preset limit



**CONTROL CONSOLE** at National Bank of Detroit has slide projector for operating instructions, system control and wiring diagrams. Typical of added central systems that can be included is coded frequency control for all electrical devices within the building

any of 17 different floor plans (3) stop any of 71 supply and exhaust fans or 16 pumps (4) check temperature at 400 different locations (5) raise or lower temperature at some 200 areas (6) change from winter to summer operation (7) check operation of electric strip heaters (8) see which air-handling fans and pumps are running (9) see and hear emergency signals indicating equipment malfunction (10) continuously record any 20 of 732 key temperatures (11) read and record steam, condenser and chilled-water flow and temperature.

**Control centers must be tailored** for each system. Photographs above illustrate abundant designs now in operation. There is a noticeable trend to add more and more functions such as (1) fire and air-raid alarm (2) clock systems (3) security surveillance with closed-circuit TV, ultrasonic alarms (4) communications centers (5) equipment operation including elevators, pumps (6) lighting (7) electrical distribution (8) steam supply and distribution. If the trend continues, tomorrow's console may truly be a plant-wide energy-systems control center.

# WATER TREATMENT

## . . . packaged systems take on more jobs

**Use of packaged equipment in the water-treatment field is definitely on the upswing. Advantages of fast shipment and low installation cost far outweigh other considerations.** The term "package" is loosely used to describe a wide variety of special equipment that can be put into three related but somewhat different classifications.

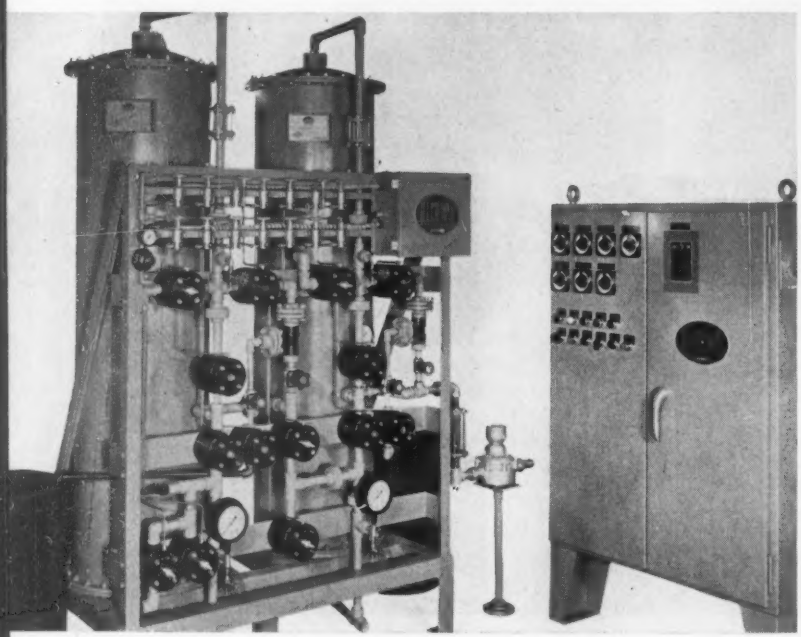
First category includes off-the-shelf items of equipment. Second covers equipment made to standardized designs using stock component parts. Final category includes both custom and standardized designs that are factory-assembled, skid-mounted and tested before shipment.

**Off-the-shelf items** include filters, softeners, demineralizers for the flow range up through 100 gpm. Deaerators are available in even larger sizes. Your big job is getting enough information—mainly flow rate, water consumption and analysis—to select the right size.

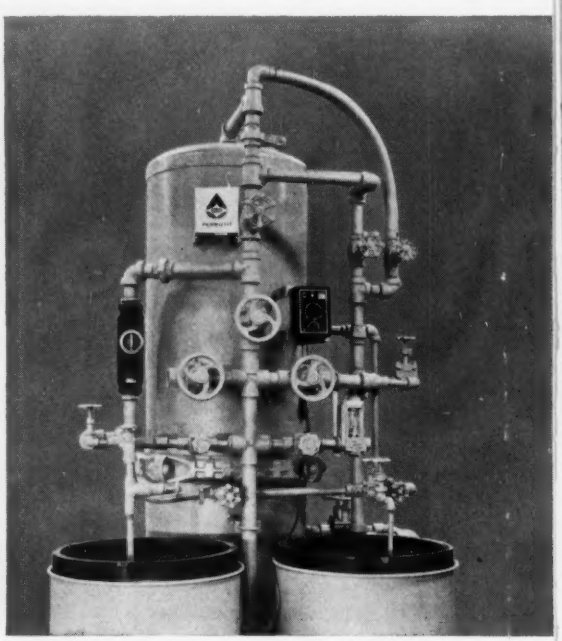
**Standardized designs** are available for practically all types of water-treating equipment. Small- and medium-capacity systems are readily assembled from standardized components, but larger systems are still custom-designed.

**Skid-mounted category** is making rapid gains. lower installation cost is the big advantage; increased mobility of equipment is another.

All three classes of packaged equipment are designed to keep water-treating costs at a minimum. Take full advantage of them in tackling your next water problem. Avoid the common mistake of using specifications that arbitrarily rule out packaged systems by calling for special features that are not absolutely essential.



**AUTOMATIC** 2-step demineralizer gives top-quality water with minimum operating labor



**MIXED BED** produces ultimate in water quality

### Off-the-shelf equipment meets many treatment needs

Packaged filters, softeners, demineralizers, chemical feeds, deaerators, etc are generally available from manufacturer's stock to solve specific water problems. Stock units are completely designed, assembled and tested and are waiting at the factory, ready for immediate shipment. On arrival at your plant only inlet, outlet, waste and electrical connections are needed to get the equipment hooked up and on-stream. Equipment of this type, shown above, is essentially mass-produced for production and purchasing economies. There's a wide range of sizes to handle flows up through 100 gpm (deaerators to 350,000 lb per hr). You can get even higher capacities off-the-shelf with multiple-unit hookups, if fast delivery is urgent.

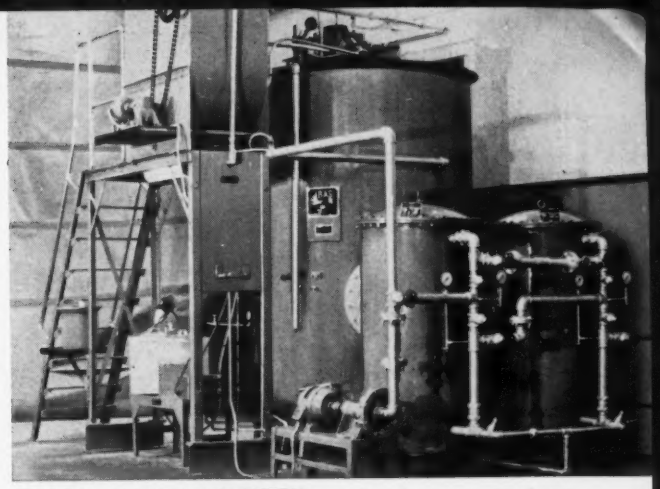
Selection depends not only on flow rate but also on water analysis and total daily water use. For example, a demineralizer for 10 gpm of high-solids water can easily be larger than a 30-gpm unit handling low-solids water. Just be sure the equipment you choose is not too small. This approach to water-treating problems has its limitations, but don't overlook the many advantages of using stock units wherever possible.

## Standardized designs: key to economic treatment system

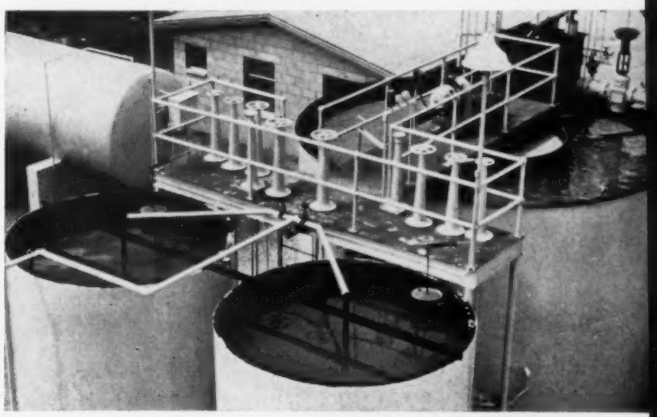
Six main parts of treating system, upper right, are (1) reaction tank (2) water controls (3) chemical feeders (4) booster and backwash pump (5) sand filter and (6) activated-carbon purifier. This system reduces hardness and alkalinity, clarifies and removes objectionable organic matter, iron, taste and odor. Clear pure water is delivered to point of use.

Design of each component part in system is standardized. Details like reaction-tank detention, maximum flow rates and metal thickness are fixed by research, test and experience. But the equipment can still be arranged to suit individual plant layout. Components are added, left out or substituted to handle each specific treatment need at a given location.

The 6-part system shown is recommended standard treatment for beverage water in the bottling industry. Chemical plant might start with cold process system, at right, and then add demineralizers for process water, softeners for boiler-feed makeup. This building-block technique focuses attention on type of treatment needed rather than design details of component parts. Result: a well-designed system using economical standardized and packaged equipment.



**COMPLETE TREATMENT SYSTEM** contains six component items

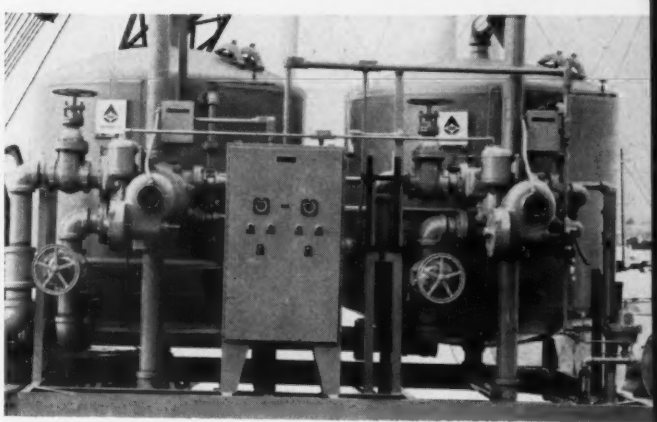


**GRAVITY FILTERS** substitute for pressure type in softening plant

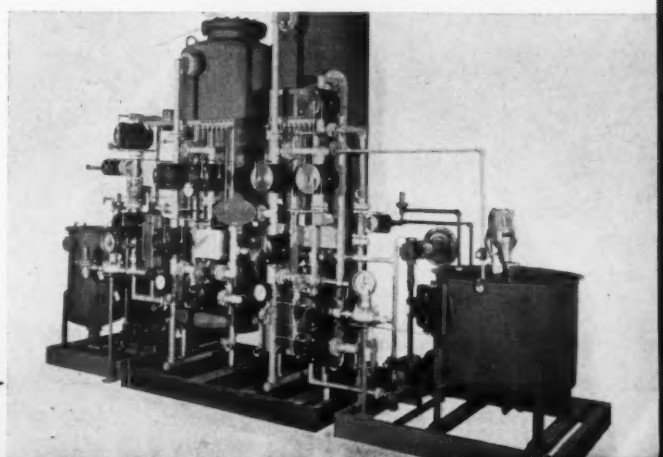
## Skid-mounted approach cuts installation costs

Another technique finding increased popularity is skid-mounted shop-assembled equipment of all types to keep installation costs at a minimum. Only limitation on size is that imposed by common carriers and ability of receiving plant to handle package at job site. Softeners at right are 7-ft-diameter automatic units destined for a new chemical plant in West Virginia. As soon as inlet, outlet, waste and electric connections are made the softeners are ready to deliver soft water to the boilers. Same plant also uses skid-mounted demineralizers for process water.

Automatic skid-mounted units, right, provide demineralized water for a high-pressure public-utility power plant. Complicated automatic controls are completely checked out at factory, avoiding expensive field assembly and major adjustments. Another important asset of skid-mounting is the mobility it gives equipment. At least one public utility plans to buy a skid-mounted demineralizer designed for complete portability. This unit will be available for emergencies, as well as normal needs that cannot be met otherwise. Since the unit will be completely portable it can go from one station to another on short notice.



**AUTOMATIC SOFTENERS** can be skid-mounted, shipped complete



**SKID-MOUNTED** automatic demineralizer simplifies installation

# F-R LUBRICANTS

## ...growing acceptance forecast

**Fire-resistant lubricants have been commercially available for some time, but they've been accepted relatively slowly. Perhaps the greatest deterrent to more-common use of F-R lubes in energy-systems machinery is an apathetic attitude on the part of users.** Every so often there's a serious fire in a compressor or turbine-generator installation—but not often enough to make users *insist* that equipment be compatible with F-R lubes when they purchase new units. And to date, this attitude has been backed up to some extent by insurance companies' refusal to give preferential rates where F-R lubes are to be used. But this situation may change in the near future: in at least one case, an insurance company has recommended F-R lubes for a turbine-generator installation. Wider acceptance — and soon—is a definite possibility.

In the last seven years many field and lab tests by suppliers, equipment manufacturers and users have pointed up problems to be overcome and, in many cases, their solution (POWER, Oct 1955, p 101; March 1956, pp 78-79; May 1958, pp 73-77).

**Main problems** revolve around materials compatibility with available F-R lubes. Unfortunately, fire-resistant lubricants are excellent paint removers. This means that lubricating systems must be whistle clean, which presents a difficult and critical cleaning problem in older equipment designed for normal lubricating oils.

**Materials compatibility** in turbine-generators goes further than internal painting and gaskets. Although this obviously is not supposed to happen, a certain amount of the lube will work its way into the generator winding—insulation deterioration results. In older units, where insulation is of the asphalt type, deterioration will be very rapid. Designers have considered spray- or dip-coating the winding with an epoxy, but most manufacturers feel that at best the results are uncertain and so they're not willing to recommend the practice. However, synthetic generator insulations in more modern units should stand up. In fact, manufacturers predict that an F-R-lube-resistant corona-suppression paint is just around the corner.

In air compressors operating at high temperatures, F-R lubes have been used with success in many instances—in one case, an insurance company *insisted* upon F-R lubes in an installation operating at high temperature and in a hazardous environment. When an old system that has operated with hydrocarbon lubricants is converted to F-R lubes, special care must be taken to account for sludge solubility in the new lube. Sludge that has built up over the years in air lines will suddenly be dissolved and the system automatically cleaned, whether you like it or not. If temperatures are high, sludge may carbonize and join the air flow, clogging operating equipment all down the line.

**Let's take a look** at the two basic F-R lube types applicable to the energy systems. These are phosphate-ester-base materials and water-base fluids containing 35 to 60% water plus glycol and a polyalkylene-glycol thickening agent (see POWER, March 1955, pp 75-79).

**The phosphate-ester lubricants** can operate at relatively high temperatures. Their auto-ignition points lie in the neighborhood of 1200 F. They span a wide range of available viscosities—from 85 to 1000 ssu at 100 F in several grades. But these phosphate-ester lubes have a low viscosity index—viscosity changes radically with temperature. For example, one particular F-R lube has a viscosity of 223 ssu at 100 F, which drops to 44.8 ssu at 200 F and goes up to 2280 at 50 F. This brings up the problem of a lubricant that's sufficiently fluid at startup but completely inadequate at full-load operating temperature. Conversely, a lube designed for adequate viscosity at operating temperatures may be too thick for a cold start-up. One answer being investigated is heated reservoirs for startup.

The phosphate-esters are relatively expensive—about six times the cost of a comparable hydrocarbon lube. Phosphate-esters drain away on shutdown, leaving an incomplete protective coating on journals and cylinders. So if service is intermittent and water vapor a possibility, a rust inhibitor should be added to the lube.

**The polyglycol F-R lubes** are somewhat less expensive, but they can't operate over 150 F. They depend upon their water content for fire resistance, so if water goes down because of evaporation at higher temperatures, all the fire-resistant qualities may be lost. Polyglycols aren't quite as much of a nuisance as the phosphate-esters when it comes to removing paint, but you'll still have to take special precautions to avoid system clogging by paint particles.

**The time is ripe** for rapid acceptance of F-R lubes. As we've seen, the lubes themselves are developed and available. Their lubricating qualities are established. Materials compatibility is well understood by suppliers and most equipment manufacturers. In the few remaining problem areas—development of a resistant corona-suppression paint is a case in point—success seems to be just around the corner. On this basis it would seem logical to assume that the long-awaited emergence of fire-resistant lubricants is imminent. It appears that only user insistence is needed to bring this about.



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**Power**
OCTOBER

# 1961 Industrial Plant Design Survey

- Tabulation of steam design data in 189 plants
- Electric-distribution details on 60 projects
- Air-conditioning facts covering 116 installations

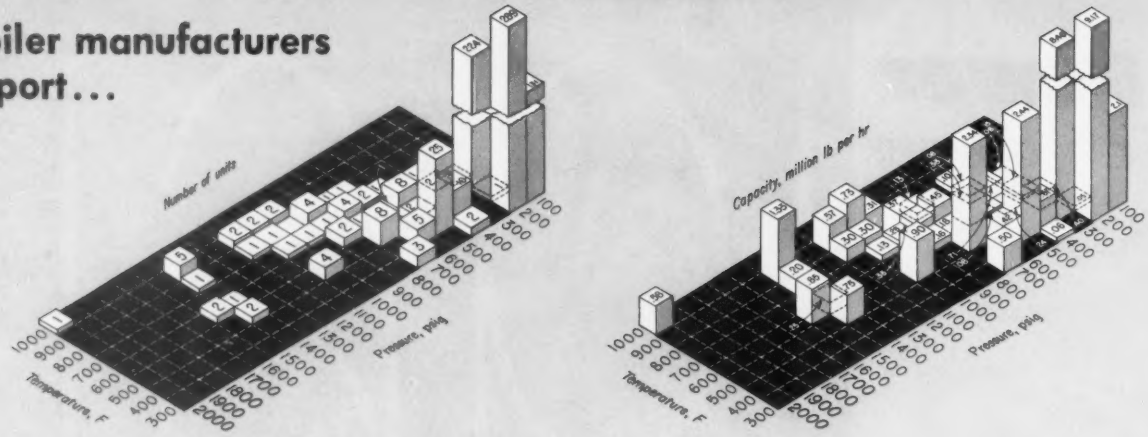
The following 23 pages contain design features and a summary of trends gleaned from newly completed or modernized industrial plants, from some still under construction, others yet on the drawing board. As we use it, the term *industrial plant* includes commercial buildings, hotels, institutions; in brief, sizable non-central-station installations. As in last year's report, this survey covers three significant energy-systems areas: *steam generation, electric distribution, air conditioning.*

Last year we reported on 68 air-conditioning installations; this year the total is 116. Electric-distribution report is the fourth of its kind to appear in print: the first appeared in POWER's October 1958 issue. The electric survey includes data right from the incoming main or primary sub, through in-plant circuitry, to loads.

But the survey has its limits because of the very way we must compile facts. We start the job by listing installations planned or on order. Then we send questionnaires asking for the details to individuals closely allied with each project. Consulting engineers, as you would expect, are a prime source of information. Although these tabulations can't be complete, they represent current design and construction, so you do get a timely, accurate idea of what trends may be shaping up.

Once again, these are not complete lists, but merely extensive samples. Don't use the survey to get total values or where incompleteness may distort results.

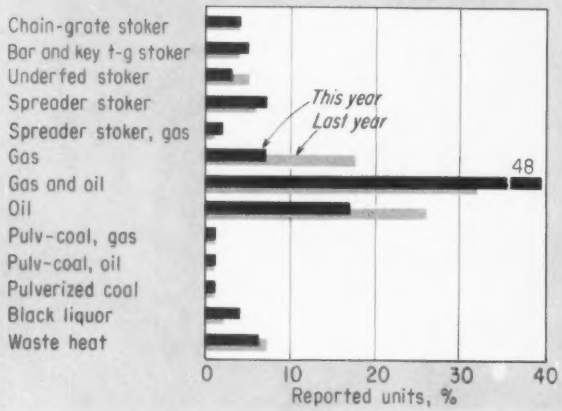
## Boiler manufacturers report...



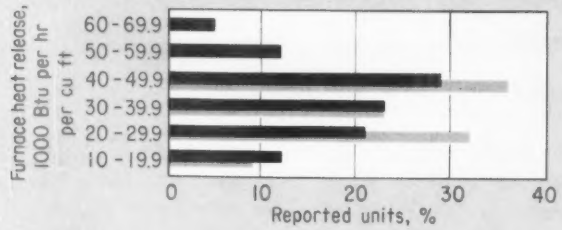

**TOTAL BOILER SALES REPORTED dropped off from last year — 759 vs 859 — but higher-pressure and-temperature units pick up some ground**

## Power survey reveals...

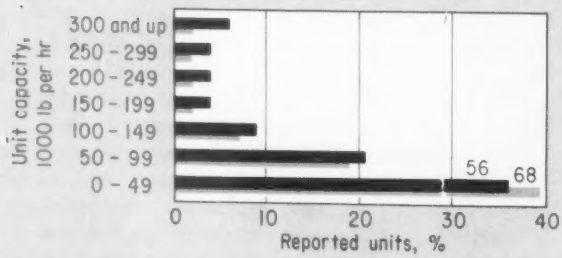
### FIRING METHODS




### HEAT RELEASE




### BOILER SIZES




**BOILER DETAILS, compared to last year, show gas-oil firing gains at the expense of separate gas- and oil-fired units. Heat-release rates over 50 Btu per hr per cu ft are reported for the first time this year. Unit capacities are up all along the line; packaged boilers dropped**

# STEAM PLANTS

## ...growth rate down slightly

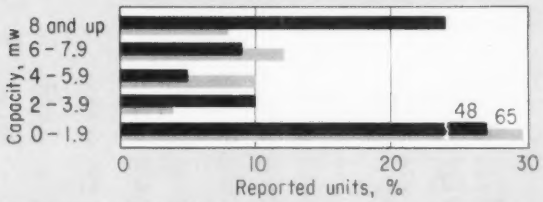
*POWER*'s survey this year reports boiler sales, above, and system trends compared to last year. We've rounded up details of 189 specific installations

From the point of view of boiler sales reported by manufacturers, this year's industrial growth rate appears to have fallen off somewhat. A cautious approach to capital expenditures marked 1960 and the first quarter of '61 (but in the last few months this has reversed; capital expenditures are on the increase). Nevertheless the number of installations we are able to cover has gained over last year, and the greater percentage of the total adds to the survey's value to you. Eight pages of listings cover design, construction and equipment details of 189 industrial steam installations in the U.S. and Canada.

This year the trend charts, left and right, show percent of reported units in each of 14 categories. And — in each case we have compared this year's data to last year. Our aim is to give you a better picture of changing trends by letting you compare the years directly. Solid color shows this year's data while last year's is shaded. Groupings of numerical data cover consistent ranges to simplify comparison.

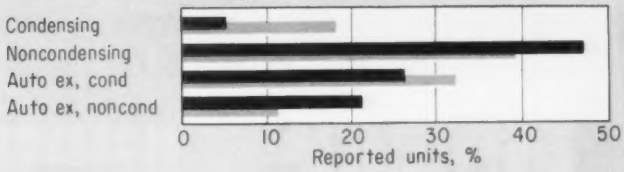
Most significant trends are (1) increased use of combined oil-gas firing (2) higher heat-release rates (3) gain in boiler sizes (4) larger turbine-generators and (5) more turbine-driven i-d fans.

## TURBINE SIZES

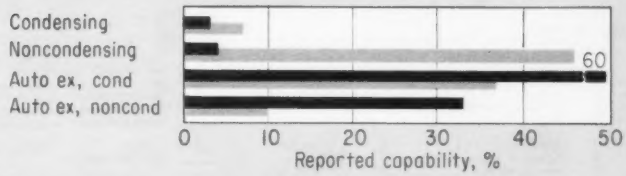



**LARGER TURBINE-GENERATORS GAIN at the expense of all ranges except 2.0 to 3.9 mw. While straight noncondensing units are up in actual number, they reflect a very small percentage of total mw. Straight condensing units dropped in both number and mw in 1960**

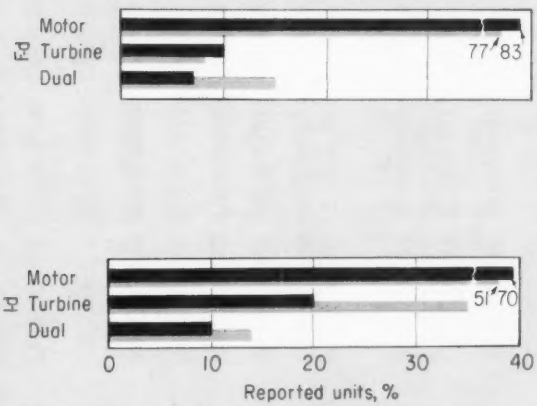
## TURBINE TYPES BY NUMBER




## TURBINE TYPES BY SIZE

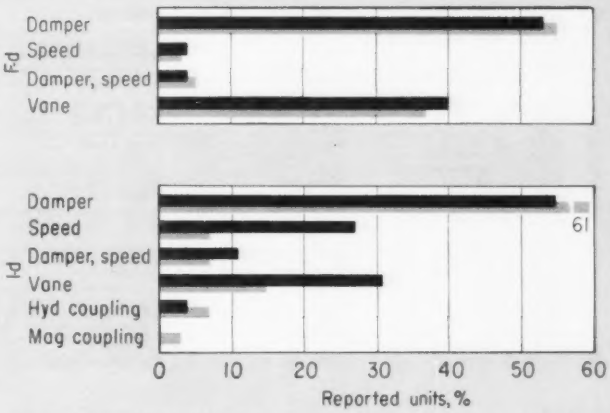



## FAN DRIVES



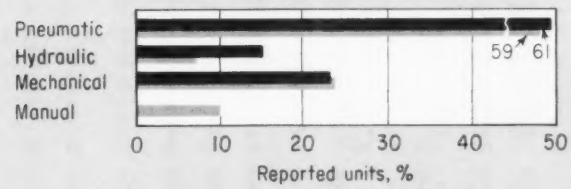

**PICTURE IS MIXED for fan drives. In f-d types, choice remains unchanged, but for i-d fans, turbine drive gains at expense of motors**

## FAN CONTROLS

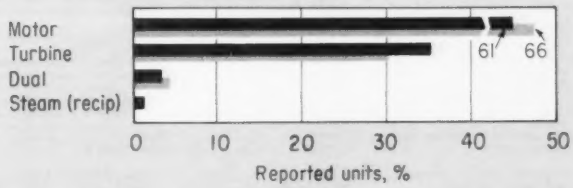



**MOST SIGNIFICANT CHANGE in fan-control picture comes in the i-d category: Damper control lost ground to vane, speed and speed-damper**

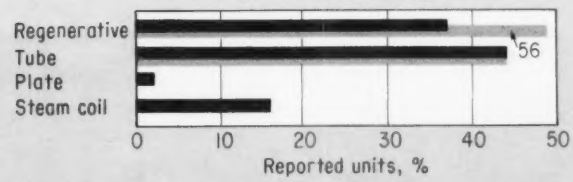
## ASH-HANDLING SYSTEMS




## FEED-PUMP DRIVES

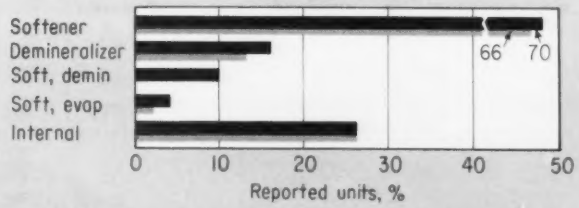



## AIR HEATERS




**HYDRAULIC ASH-REMOVAL SYSTEMS gained this year over last. Regenerative air heaters fell back and tube type remained unchanged**

## FEEDWATER TREATMENT




**MOTOR-DRIVEN BOILER-FEED PUMPS gained again this year over turbine drive. Softener-demineralizer treatment shows up this year**

Table 1

# 1961 design survey: typical industrial,

Note that each listing covers 4 pages. Project number helps you track a specific installation after you turn facing page

| | Company | Location | Consulting engineers | New or existing plant | Date of initial operation | Principal steam use | BOILERS: No. of new boilers | Manufacturer | Operating pressure, psig | Operating temperature, F | Boiler type | Capacity each, 1000 lb per hr | SURFACE, 1000 SQ FT: Boiler and waterwalls | Economizer | Superheater | Air heater |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1300 TO 601 PSIG** | | | | | | | | | | | | | | | | |
| 1 | Dow Chemical Co | Plaquemine, La | | Ex | ..... | Po | 1 | BW | 1300 | 950 | WT | 750 | ..... | ..... | ..... | ..... |
| 2 | Dow Chemical Co | Midland, Mich | Commonwealth Associates, Inc | Ex | 1961 | Po, Pr | 1 | RS | 1250 | 900 | WT | 650 | 30.1 | 14.1 | 23.2 | 128.2 |
| 3 | International Paper Co | Pine Bluff, Ark | Self | Ex | 12-60 | Po, Pr | 1 | BW | 1250 | 900 | WT | 202 | 27 | 13 | 12.5 | 22 |
| 4 | Southwest Forest Industries Inc | Snowflake, Ariz | Rust Engineering Co | New | 1961 | Po | 1 | BW | 1250 | 900 | ..... | 350 | ..... | ..... | ..... | ..... |
| 5 | Southwest Forest Industries Inc | Snowflake, Ariz | Rust Engineering Co | New | 1961 | Pr | 1 | BW | 1250 | 900 | ..... | 121 | ..... | ..... | ..... | ..... |
| 6 | Calcasieu Paper Co | Elizabeth, La | Nelson Miner & Co | New | 1961 | Po | 1 | BW | 925 | 850 | WT | 220 | 15.6 | ..... | 5.4 | 25.0 |
| 7 | Allied Chemical Corp | Syracuse, N Y | | Ex | 12-60 | Pr | 1 | BW | 875 | 740 | WT | 200 | 19 | ..... | ..... | 40 |
| 8 | Marathon Southern Corp | Naheola, Ala | Rust Engineering Co | Ex | 11-60 | Po | 1 | BW | 875 | 825 | WT | 181 | 32.5 | 5.5 | 9.8 | 22 |
| 9 | International Paper Co | Moss Point, Miss | | Ex | 1962 | Po | 1 | BW | 860 | 825 | WT | 300 | 28.8 | N | ..... | ..... |
| 10 | Southern Land, Timber & Pulp Corp | Cedar Springs, Ga | J E Sirrine Co | New | 1962 | Pr | 1 | BW | 850 | 900 | WT | 600 | ..... | 8.1 | ..... | ..... |
| 11 | Southern Land, Timber & Pulp Corp | Cedar Springs, Ga | J E Sirrine Co | New | 1962 | Pr | 1 | BW | 850 | 900 | WT | 307 | 38.3 | 17.1 | 23.6 | ..... |
| 12 | Copolymer Rubber & Chemical Corp | Baton Rouge, La | | Ex | 1961 | Po, Pr | 1 | WI | 725 | 740 | WT | 220 | 17.7 | ..... | ..... | 13.7 |
| 13 | Gulf Oil Corp | Port Arthur, Texas | | Ex | 1962 | Pr | 1 | BW | 710 | 675 | ..... | 450 | 35.9 | 25.9 | 4.2 | N |
| 14 | Oxford Paper Co | Rumford, Me | Rust Engineering Co | Ex | 7-60 | Po, Pr | 1 | CE | 700 | 725 | WT | 135 | 5.6 | 12.7 | 7.3 | 8.3 |
| **600 TO 301 PSIG** | | | | | | | | | | | | | | | | |
| 15 | Fibreboard Paper Products Corp | Antioch, Calif | Bechtel Corp | Ex | 9-60 | Pr | 1 | BW | 600 | 715 | WT | 197 | 41.8 | 8.3 | 6.4 | ..... |
| 16 | Honolulu Gas Co Ltd | Honolulu, Hawaii | | Ex | 1961 | Pr | 1 | BW | 600 | 490 | WT | 40 | ..... | ..... | N | ..... |
| 17 | MacMillan, Bloedel & Powell River Ltd | Port Alberni, B C, Canada | H A Simons | Ex | 1962 | Po, Pr | 1 | BW | 600[13] | 750 | WT | 350 | 32.5 | ..... | ..... | 76.6 |
| 18 | Monochem Inc | Geismar, La | United Engineers & Constructors | ..... | 1962 | Po, Pr | 2 | WI | 600 | 750 | ..... | 175 | ..... | ..... | ..... | ..... |
| 19 | Weyerhaeuser Co | Longview, Wash | | Ex | 1961 | Pr | 1 | BW | 600 | 715 | WT | 350 | 26.8 | N | ..... | 51.7 |
| 20 | Parke, Davis & Co | Holland, Mich | A M Kinney, Inc | ..... | ..... | Po, Pr | 1 | WI | 575 | 650 | WT | 50 | 5.2 | ..... | 0.4 | 3.4 |
| 21 | Parke, Davis & Co | Rochester, Mich | Smith, Hinchman & Grylls | Ex | 1961 | Pr | 1 | WI | 100[11] | Sat | WT | 40 | 4.8 | ..... | 0.3 | ..... |
| 22 | Dominion Steel & Coal Corp Ltd | Sydney, Nova Scotia | Hanright & Co Ltd | Ex | 1961 | Po, Pr | 1 | BWG | 460 | 770 | WT | 250 | 36.7 | 7.2 | ..... | 37 |
| 23 | Adolph Coors Co | Golden, Colo | | Ex | 1961 | Po, Pr | 1[10] | UI | 450 | 750 | WT | 40 | 4.0 | N | ..... | 3.4 |
| 24 | Corn Products Co | Pekin, Ill | Sargent & Lundy | Ex | 1960 | Pr | 1 | CE | 450[12] | 580 | WT | 270 | 7.6 | ..... | 1.2 | 50.2 |
| 25 | Penobscot Chemical Fibre Co | Old Town, Me | C T Main | New | 7-61 | Pr | 1 | CE | 450 | 750 | WT | 114 | 14 | 5 | 7 | 12 |
| 26 | Chas F Kettering Memorial Hospital | Dayton, Ohio | Helmig-Lienesch & Assoc | New | 1963 | Pr, SH | 2[6] | BW | 440 | 410 | WT | 22.5[2] | 1.8 | ..... | ..... | ..... |
| 27 | St Regis Paper Co | Tacoma, Wash | Rubens & Pratt | Ex | 1961 | Pr | 1 | BW | 425 | 750 | WT | 180 | ..... | ..... | ..... | ..... |
| 28 | St Regis Paper Co | Tacoma, Wash | Rubens & Pratt | Ex | 1961 | Pr | 1 | CE | 425 | 750 | WT | 215 | ..... | ..... | ..... | ..... |
| 29 | Union Carbide Chemicals Co | Institute, W Va | | Ex | 3-60 | Pr | 1 | BW | 425 | 575 | WT | 40 | 10.9 | 10.6 | 0.9 | ..... |
| 30 | Anglo-Canadian Pulp & Paper Mills Ltd | Quebec, P Q, Canada | Self | Ex | 1962 | Pr | 1 | CE | 420[9] | 550 | WT | 250 | 17.1 | N | ..... | 24.1 |
| 31 | International Paper Co | Corinth, N Y | | Ex | 1961 | Po, Pr | 1 | BW | 415 | 650 | WT | 80 | ..... | N | ..... | ..... |
| 32 | International Salt Co | Watkins Glen, N Y | | Ex | 1962 | Po, Pr | 1 | BW | 410 | 600 | WT | 77 | ..... | ..... | ..... | ..... |
| 33 | Chicago Housing Authority | Chicago, Ill | John Dolie & Assoc | New | ..... | SH | 3[6] | BW | 400 | 400 | WT | 300[2] | 9.0 | ..... | ..... | ..... |
| 34 | Mobil Chemical Co | Beaumont, Texas | | New | 1961 | Pr | 18 | MWK | 400 | Sat | WT | 19.5 | 18.4 | ..... | ..... | ..... |
| 35 | Mobil Chemical Co | Beaumont, Texas | | New | 1961 | Pr | 4 | ..... | 400 | Sat | WT | 23 | 18.4 | N | N | N |
| 36 | Moraine Paper Co | West Carrollton, Ohio | Oberle-Jordre, Inc | Ex | 7-61 | Po, Pr | 1 | BW | 400 | 625 | WT | 100 | 10.7 | 5.7 | 1.6 | N |
| 37 | Standard Oil Co of Texas | El Paso, Texas | | Ex | 1961 | Pr | 1 | RS | 400 | 600 | WT | 75 | ..... | ..... | ..... | ..... |
| 38 | Gates Rubber Inc | Nashville, Tenn | Rust Engineering Co | New | 11-59 | Pr | 2 | CE | 350 | 450 | WT | 30 | 4.8 | N | ..... | N |
| 39 | Iron Ore Co of Canada | Carol Project, Labrador | Bechtel Corp | New | 1961 | SH | 2[6] | DB | 350 | 400 | WT | 30[2] | 3.9 | ..... | ..... | ..... |
| 40 | Colorado State College | Greeley, Colorado | Riley Engineering Corp | Ex | ..... | SH | 1[6] | CE | 325 | 400 | WT | 60[2] | 1.4 | N | N | N |
| **300 TO 201 PSIG** | | | | | | | | | | | | | | | | |
| 41 | Dulles International Airport | Chantilly, Va | Burns & McDonnell | New | ..... | ..... | 2[6] | CE | 300 | 380 | WT | 30[2] | 2.7 | ..... | ..... | ..... |
| 42 | Koppers Co, Inc | Monroeville, Pa | | New | ..... | SH | 1 | CE | 300 | Sat | WT | 35 | ..... | ..... | ..... | ..... |
| 43 | Remington Rand Div, Sperry Rand Corp | Elmira, N Y | Self | Ex | 1961 | Pr, SH | 2 | UI | 300 | Sat | WT | 80 | 11.7 | 1.9 | 0.2 | N |
| 44 | Collyer Insulated Wire Co | Lincoln, R I | Wright & Cunningham | New | 1961 | Pr, SH | 2 | BW | 280 | Sat | WT | 27 | ..... | ..... | ..... | ..... |
| 45 | AEC, Kansas City Area Office | Kansas City, Mo | Lutz, Daily & Brain | New | 1961 | Pr | 3 | WI | 275 | Sat | WT | 55 | 6.1 | ..... | ..... | ..... |
| 46 | Van-Evan Co | Missoula, Mont | Cargate Industries Ltd | New | 8-60 | Pr | 1 | BW | 265 | Sat | WT | 50 | ..... | ..... | ..... | ..... |
| 47 | Boise Cascade Kraft Corp | Wallula, Wash | | Ex | 1961 | Pr | 1 | BW | 260 | 580 | WT | 140 | 12.2 | ..... | ..... | ..... |
| 48 | Boise Cascade Kraft Corp | Wallula, Wash | | Ex | 1961 | Pr | 1 | BW | 260 | 580 | WT | 100 | 19.9 | ..... | ..... | ..... |
| 49 | American Cyanamid Co | Wayne, N J | Self | New | 1962 | SH | 2 | MI | 250 | Sat | WT | 30 | ..... | ..... | ..... | ..... |
| 50 | S Bent & Bros, Inc | Gardner, Mass | | Ex | 2-60 | Po | 1 | BW | 250 | Sat | WT | 20 | 2.5 | ..... | ..... | ..... |
| 51 | B F Goodrich Co | Akron, Ohio | | Ex | 1961 | Pr, SH | 1 | BW | 250 | 525 | WT | 125 | 13.5 | N | 1.2 | N |
| 52 | Granite City Steel Co | Granite City, Ill | Sverdrup & Parcel | New | 1960 | Pr | 1 | CE | 250 | 500 | WT | 150 | 17 | ..... | 0.7 | 13.5 |
| 53 | Hastings State Hospital | Hastings, Minn | Jos V Edeskuty & Assoc | Ex | 1959 | Po, SH | 3 | CE | 250 | 500 | WT | 40 | ..... | ..... | 0.4 | 1.7 |
| 54 | Hercules Powder Co | Savannah, Ga | | Ex | ..... | Pr | 1 | WI | 250 | Sat | WT | 60 | ..... | ..... | ..... | ..... |
| 55 | Husky Oil Co | Cody, Wyo | | Ex | 1961 | Pr | 1 | WI | 250 | Sat | WT | 50 | 5.8 | ..... | ..... | ..... |
| 56 | Pennsylvania State University | University Park, Pa | H F Lenz Co | Ex | 1961 | SH | 1 | WI | 250 | 530 | WT | 110 | 11.2 | 9.2 | ..... | N |
| 57 | Texaco, Inc | Wilmington, Calif | | New | 1960 | Pr | 1 | BW | 250 | 450 | ..... | 275 | ..... | ..... | ..... | ..... |
| 58 | Columbia River Paper Co | Vancouver, Wash | | Ex | 1961 | Pr | 1 | EC | 240 | Sat | WT | 110 | 10.5 | ..... | ..... | 8.3 |
| 59 | Southwest Forest Industries, Inc | Prescott, Ariz | Taco Corp | Ex | 3-61 | Pr | 1 | CE | 240 | Sat | WT | 15 | 1.5 | ..... | ..... | ..... |
| 60 | Campbell Soup Co | Chicago, Ill | Sargent & Lundy | Ex | 1962 | Pr | 1 | EC | 235 | Sat | WT | 100 | 10.4 | 4.5 | N | N |
| 61 | Community Mem Gen'l Hospital | La Grange, Ill | Schmidt, Garden & Erickson | Ex | 1961 | Pr, SH | 2 | BW | 235 | Sat | WT | 14 | 1.5 | ..... | ..... | ..... |
| 62 | James Lees & Sons Co | Rabun Gap, Ga | H A Kuljian, Inc | Ex | 12-59 | Pr, SH | 1 | CE | 235 | Sat | WT | 32 | 3.8 | ..... | ..... | ..... |
| 63 | Los Angeles Dept of Airports | Los Angeles, Calif | J S Hamel | New | 1961 | SH | 3[6] | CE | 230 | 380 | WT | 22[2] | 1.8 | ..... | ..... | ..... |
| 64 | Southern Dyestuff Co Div | Mt Holly, N C | | Ex | 1961 | Pr | 1 | UI | 230 | Sat | WT | 60 | 8.1 | ..... | ..... | ..... |
| 65 | Firestone Tire & Rubber Co | Pottstown, Pa | Day & Zimmermann, Inc | Ex | 1961 | Pr | 1 | BW | 225[8] | Sat | WT | 100 | 11.2 | ..... | ..... | ..... |
| 66 | Kimberly-Clark Corp | Fullerton, Calif | | Ex | 11-60 | ..... | 1 | BW | 225 | Sat | WT | 45 | 4.0 | N | N | N |
| 67 | National Lead Co | Sayreville, N J | | New | 10-60 | Pr | 1 | CE | 225 | Sat | WT | 40 | 3.5 | ..... | ..... | ..... |
| 68 | University of California at L A | Los Angeles, Calif | Storms & Lowe | New | 1961 | SH | 1 | BW | 225 | 390 | WT | 20[7] | 2.2 | ..... | ..... | ..... |
| 69 | Goodrich-Gulf Chemicals Inc | Institude, W Va | | New | 1960 | Pr | 1[14] | VO | 220 | Sat | WT | 40 | 1.0 | ..... | ..... | 4.0 |
| 70 | Cooper Tire & Rubber Co | Findlay, Ohio | Cummins & Barnard Inc | Ex | 1959 | Pr, SH | 1 | UI | 210 | Sat | WT | 75 | 10.3 | 3.4 | ..... | ..... |
| 71 | University of Massachusetts | Amherst, Mass | Merrill Associates | Ex | 1961 | SH | 2 | UI | 205 | 450 | WT | 80 | ..... | ..... | ..... | N |

SYMBOLS USED ABOVE

BD - Balanced draft
BE - Bucket elevator
Be - Belt
BFG - Blast furnace gas
Bk - Bark
BKE - Bar and key stoker
BL - Black liquor
Bn - Bunker
Br - Burner
Bu - Bulldozer
C - Coal, bituminous
CDS - Continuous discharge spreader stoker
CG - Chain grate stoker
Ch - Chute
CO - Carbon monoxide
CrB - Crane and bucket
CS - Car shaker
CV - Cyclone venturi
Cy - Cyclone
DB - Dry bottom
DGS - Dump grate stoker
DS - Drag scraper
El - Electrostatic
Ex - Existing
Fl - Flight
FT - Fire tube
G - Gas
Me - Mechanical
MF - Mass flow
N - None
O - Oil
ON - Oscillating nozzles
OS - Oscillating grate
PC - Pulverized coal
Pd - Pressurized
Pl - Plate
Po - Power
Pr - Process
Pre - Precipitator
RC - Rotary cup burner
Re - Regenerative
Rg - Register gas burner
Ro - Register oil burner
Rog - Register oil-gas burner
RR - Railroad
Sat - Saturated
SC - Steam coil
SH - Space heat
ST - Slag tap
Sto - Stoker
TH - Track hopper
Tr - Truck
Tu - Tubular
VG - Vibrating grate stoker
VS - Venturi scrubber
W - Water
Wd - Wood
WG - Waste gas
WH - Waste heat
WL - Weigh larry
WT - Water tube
WW - Wood waste

# institutional plants above 200 psig

| Furnace volume 1000 cubic feet | Furnace heat release 1000 Btu per cu ft per hr | Furnace type | Air heater type | Air heater manufacturer | Dust collector type | Dust collector manufacturer | NEW FIRING EQUIPMENT: Firing method | Grate area, sq ft | Stoker manufacturer | Fuel | Heating value 1000 Btu per lb | COAL HANDLING EQUIPMENT: Delivery method to plant site | Unloading equipment | Manufacturer | Stockpiling method | Stockpile to in-plant storage | Manufacturer | Covered storage facility | Manufacturer | In-plant handling equipment | Manufacturer | Weighing equipment | Manufacturer | Project Number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ..... | ..... | Pd | Re | ..... | ..... | ..... | Br | ..... | ..... | O,G | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1 |
| 48.0 | 18.5 | St, Pd | Re | APr | Me | RC | PC | ..... | ..... | C | 12.0 | RR | CS,TH | ..... | ..... | Be | LB | Bn | ..... | Be,BE | LB | ..... | ..... | 2 |
| 27 | 10 | BD,ST | Tu | BW | VS | BW | Br | ..... | ..... | BL | 6.5 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 3 |
| ..... | ..... | Pd,DB | Re | APr | ..... | ..... | Rog | ..... | ..... | G | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 4 |
| ..... | ..... | BD,ST | Tu | APr | ..... | ..... | Rog | ..... | ..... | BL | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 5 |
| 10.8 | 25.1 | Pd | Tu | BW | ..... | ..... | Rog,DGS | 116.4 | DSC | O,G,Bk | 1050[1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 6 |
| ..... | ..... | ..... | Tu | BW | El | AT | PC | ..... | ..... | C | 13 | RR | CS,TH | ..... | Bu,CrB | Be,BE | ..... | ..... | ..... | Be | ..... | ..... | ..... | 7 |
| 30.8 | ..... | ST | Tu | BW | CV | BW | Br | ..... | ..... | O,BL | 6.5 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 8 |
| 16.8 | ..... | BD,DB | Re | APr | Me | BU | CDS | 306 | DSC | Bk,G | 4.5 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 9 |
| 32.8 | ..... | Pd | Tu | BW | Me | WP | PC,Rog, BKE | 660 | DSC | C,O,G, Bk,Coke | 12 | W,RR | TH,CrB | ..... | Bu | Be | ..... | Bn | ..... | MF | BW | ..... | ..... | 10 |
| 51.9 | ..... | Pd | SC | AS | El,Pre | KC | Rog | ..... | ..... | BL | 6.5 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 11 |
| 8.5 | 27 | Pd | Re | APr | N | ..... | Rog | ..... | ..... | G,O | 1000[1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 12 |
| ..... | ..... | DB,Pd | N | ..... | N | ..... | Rog | ..... | ..... | WH[3] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 13 |
| 21.9 | ..... | ST | SC | AS | El | KC | Br | ..... | ..... | O,BL | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 14 |
| 32 | 11 | ST | SC | AS | El | KC | Br | ..... | ..... | BL,O | 6.6 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 15 |
| ..... | ..... | BD | SC | ..... | N | ..... | Rog | ..... | ..... | O,Tar | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 16 |
| 18.8 | 20.4 | BD | Tu,SC | ..... | Me | WP | CDS | ..... | ..... | Wd,BK,O | 3.45 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 17 |
| ..... | ..... | Pd | Re | APr | ..... | ..... | Rg | ..... | ..... | G,WG | 1050[1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 18 |
| 12.7 | ..... | Pd | Re | APr | N | ..... | Rog | ..... | ..... | O,G | 18 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 19 |
| 1.0 | 63 | Pd | Re | APr | ..... | ..... | Br | ..... | ..... | G,O | 1000[1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 20 |
| 1.1 | 45 | Pd | ..... | ..... | ..... | ..... | Rog | ..... | ..... | G,O | 1000[1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 21 |
| 18.4 | 17.9 | BD | Tu | BWG | Me | RCL | Rog | ..... | ..... | O[5] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 22 |
| 1.3 | 62.5 | Pd | Tu | UI | ..... | ..... | Rog | ..... | ..... | G,O | 830[1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 23 |
| 20.4 | 15.5 | BD,DB | Tu | CE | Me | WP | PC | ..... | ..... | C | 10 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Be | COB | ..... | ..... | 24 |
| 19 | ..... | ..... | SC | AS | ..... | ..... | Br | ..... | ..... | BL | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 25 |
| 0.7 | ..... | Pd | ..... | ..... | ..... | ..... | Rog | ..... | ..... | O,G | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 26 |
| ..... | ..... | DB,Pd | Re,SC | APr | ..... | ..... | Rog | ..... | ..... | O | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 27 |
| ..... | ..... | BD,ST | SC | APr | El | RC | Rog | ..... | ..... | BL | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 28 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | Br | ..... | ..... | WH | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 29 |
| 10.2 | ..... | BD,DB | Tu,SC | ..... | Me | WP | Rog | ..... | ..... | O | 18.0 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 30 |
| ..... | ..... | DB,Pd | Pl | APr | N | ..... | Ro | ..... | ..... | O | 18.5 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 31 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | CG | 214 | ..... | C | 13.8 | RR | CS,TH | ..... | ..... | Be | ..... | Bn | ..... | ..... | ..... | ..... | ..... | 32 |
| 2.6 | ..... | Pd | ..... | ..... | ..... | ..... | Rog | ..... | ..... | G,O | 1000[1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 33 |
| ..... | ..... | BD | ..... | ..... | N | ..... | ..... | ..... | ..... | WH | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 34 |
| ..... | ..... | BD | ..... | ..... | ..... | ..... | ..... | ..... | ..... | WH | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 35 |
| 4.9 | 27.7 | BD | ..... | ..... | Me | RC | CDS | 206 | DSC | C | 12.1 | RR | TH | WM | Bu | Be,BE | WM | Bn | WM | BE | ..... | Scale | SE | 36 |
| ..... | ..... | DB,Pd | N | ..... | N | ..... | Rg | ..... | ..... | CO,G | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 37 |
| ..... | ..... | BD | ..... | ..... | ..... | ..... | Br | ..... | ..... | O,G | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 38 |
| 760 | 46.8 | Pd | ..... | ..... | ..... | ..... | Rog | ..... | ..... | O | 18 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 39 |
| 5.0 | ..... | ..... | ..... | ..... | ..... | ..... | Rog | ..... | ..... | O,G | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 40 |
| 0.5 | 50 | Pd | ..... | ..... | ..... | ..... | Br | ..... | ..... | O,G | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 41 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | Br | ..... | ..... | O,G | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 42 |
| 3.8 | 26.1 | BD | ..... | ..... | Me | RC | CDS,OS | 183.5 | DSC | C | 13.5 | RR | TH,CrB | ..... | ..... | BE | WM | ..... | ..... | ..... | ..... | ..... | ..... | 43 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | Rog | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 44 |
| 1.3 | 54 | Pd | ..... | ..... | ..... | ..... | Rog | ..... | ..... | G,O | 935[1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 45 |
| ..... | ..... | Pd | ..... | ..... | ..... | ..... | Br | ..... | ..... | G,O | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 46 |
| ..... | ..... | BD | Re | APr | ..... | ..... | Rog | ..... | ..... | G | 1000[1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 47 |
| ..... | ..... | BD | SC | AS | ..... | ..... | ON | ..... | ..... | BL | 6.5 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 48 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | Rog | ..... | ..... | O,G | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 49 |
| 0.9 | 23 | BD | ..... | ..... | ..... | ..... | ..... | ..... | ..... | WW,O | 0.8 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 50 |
| 7.3 | 24.7 | BD,DB | ..... | ..... | Me | WP | CDS | 301 | DSC | C | 11.0 | Tr | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Scale | BB | 51 |
| 9.3 | 21.4 | BD | Tu | ..... | ..... | ..... | Rog | ..... | ..... | BFG,G,O | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 52 |
| 1.8 | 33.0 | BD | Tu | CE | ..... | ..... | Rog | ..... | ..... | G,O | 1000[1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 53 |
| ..... | ..... | Pd | ..... | ..... | ..... | ..... | Rog | ..... | ..... | O | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 54 |
| 1.4 | 51.5 | Pd | ..... | ..... | ..... | ..... | Rog | ..... | ..... | G | 1100[1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 55 |
| 4.9 | 28.7 | BD | ..... | ..... | Me | PD | VG | 345 | DSC | C | 13.0 | Tr | TH | ..... | Bu | ..... | ..... | Bn | BB | WL | BB | ..... | ..... | 56 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | Br | ..... | ..... | O,G | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 57 |
| 1.6 | ..... | Pd | Tu | ..... | ..... | ..... | Rog | ..... | ..... | G,O | 1000[1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 58 |
| ..... | ..... | BD | ..... | ..... | ..... | ..... | Rog | ..... | ..... | G | 1000[1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 59 |
| 4.5 | 26.5 | BD | ..... | ..... | Me | ..... | CDS | 182 | DSC | C | 11.6 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 60 |
| 0.4 | 42.5 | Pd | ..... | ..... | ..... | ..... | Rog | ..... | ..... | G,O | 1100[1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 61 |
| 0.9 | ..... | Pd | ..... | ..... | ..... | ..... | Br | ..... | ..... | O | 18.7 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 62 |
| 0.3 | 95 | Pd | ..... | PEC | ..... | ..... | Br | ..... | ..... | G,O | 1060[1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 63 |
| 2.5 | 30.3 | Pd | ..... | ..... | ..... | ..... | VG | 195.2 | DSC | C | 14.4 | RR | TH | FE | ..... | Be | FE | Silo | MCC | Ch | SE | ..... | ..... | 64 |
| ..... | ..... | BD,DB | Tu | BW | Me | WP | PC,Rog | ..... | ..... | C,O | 13.5 | RR,Tr | CS,TH | HR | Bu | FI | BB | Bn | MP | Be,BE | BB | Scale | BB | 65 |
| 1.1 | 49.6 | Pd | ..... | ..... | ..... | ..... | Br | ..... | ..... | O,G | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 66 |
| 1.0 | 51.8 | Pd | ..... | ..... | ..... | ..... | Br | ..... | ..... | O | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 67 |
| 0.6 | 43.0 | Pd | ..... | ..... | ..... | ..... | Rog | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 68 |
| ..... | ..... | Pd | ..... | ..... | ..... | ..... | Rog | ..... | ..... | G | 1.1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 69 |
| 3.8 | ..... | BD | ..... | ..... | Me | WP | BKE | 138 | RS | C | 12.6 | RR | TH | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 70 |
| ..... | ..... | BD | ..... | ..... | N | ..... | Sto | ..... | ..... | C | 13.0 | RR,Tr | TH | ..... | Bu,DS | Be | ..... | Bn | ..... | Be | SA | ..... | ..... | 71 |

1 - Btu per cu ft
2 - Million Btu per hr
3 - And fluid cat-cracker regenerator gas
4 - Future 950 psig, 900 F
5 - And coke oven gas, blast furnace gas
6 - High temperature water
7 - And 16 million Btu per hr
8 - Future 875 psig, 750 F
9 - Future 800 psig, 825 F
10 - Revised data, perviously listed 10-60
11 - Future 570 psig, 650 F
12 - Future 900 psig, 700 F
13 - Future 1350 psig
14 - Rented

MANUFACTURERS

AC - Allis-Chalmers Mfg Co
AL - Aladdin Heating Corp
AM - American-Marsh Pumps, Inc
APr - Air Preheater Corp
AS - American Standard, Ind Div
ASH - Allen-Sherman-Hoff Co
AT - Aerotec Corp
AU - Aurora Pump Div
BB - Beaumont Birch Co, Inc
BEE - Brush Electrical Engineering Co Ltd
BEL - Belco Ind Equipment Div Inc
BF - Buffalo Forge Co
BJ - Byron Jackson Pumps, Inc
BM - Bailey Meter Co
BP - Bingham Pump Co
BU - Buell Engineering Co Inc
BW - Babcock & Wilcox Co
BWG - Babcock-Wilcox & Goldie-McCulloch
CC - Coen Co
CE - Combustion Engineering Inc
CF - Clarage Fan Co
CGE - Canadian General Electric Co
COB - CO Bartlett & Snow Co
COC - Cochrane Corp
COP - Copeus Engineering Corp
CS - Canadian Sirocco Ltd
CT - Carling Turbine-Blower Co
CV - Copes-Vulcan Div, Blaw-Knox Co
DB - Dominion Bridge Ltd
DBP - Dean Brothers Pumps, Inc
DL - DeLaval Steam Turbine Co
DHP - Dean Hill Pump Co
DP - Diamond Power Specialty Corp
DSC - Detroit Stoker Co
DUR - Durabilt Conveying Systems
ECA - Electronics Corp of America
EC - Erie City Iron Works
EE - English Electric Canada
EL - Elliott Co
EM - Electric Machinery Mfg Co
ES - Elgin Softener Corp
FA - Fly Ash Arrestor Corp
FE - Fairfield Engineering Co

# Industrial power plants above 200 psig

**Table 1 continued**

| Project Number | F.D. FANS | | | I.D. FANS | | | AIR & GAS FLOW CONTROL | | SOOT BLOWERS | | | | | FEED WATER PUMPS | | | | | | WATER TREATMENT | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. and drive | Fan manufacturer | Drive manufacturer | No. and drive | Fan manufacturer | Drive manufacturer | Air flow | Gas flow | No. per boiler | Type | Manufacturer | Ash handling system | Manufacturer | No. per boiler | Pump manufacturer | Drive type | Drive manufacturer | Pump control | Flow rate, gpm | Softening | Demineralizing | Manufacturer |
| 1 | 2M | ..... | ..... | ..... | ..... | ..... | V | D | ..... | ..... | ..... | ..... | ..... | 1 | AC | M | ..... | R | ..... | ..... | ..... | ..... |
| 2 | 2M | SW | AC | N | ..... | ..... | D | ..... | N | ..... | ..... | Hyd | UC | 2 | AC | T | GE | S | 6 | ..... | De | BEL |
| 3 | 1T | SW | SE | 1T | WE | WE | D | S | 28 | ..... | DP | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Mu | PM |
| 4 | 1M | SW | GE | N | ..... | ..... | V | ..... | ..... | ..... | ..... | ..... | ..... | 315 | BJ | 2M,1T | GE | ..... | 400 | ..... | Mu | GW |
| 5 | 1M | FA | GE | 1M | SW | GE | V | S | 17 | St | DP | ..... | ..... | 315 | BJ | 2M,1T | GE | ..... | 400 | ..... | Mu | GW |
| 6 | 2M | SW | GE | 2M | SW | GE | D,V | D | 6 | St | DP | Hyd | UC | 2 | IR | 1M,1T | GE,EL | R | ..... | ..... | ..... | ..... |
| 7 | 1M | SW | GE | 1M | SW | GE | D | D | 2 | St | DP | Hyd | ..... | 1 | BJ | T | GE | S | ..... | HLZ | ..... | ..... |
| 8 | 1M | CF | AC | 2T | CF | WE | V | S | 22 | St | DP | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 9 | 1T | SW | WE | 1T | SW | WE | S | D | ..... | ..... | ..... | ..... | ..... | 1 | WO | T | WE | ..... | ..... | ..... | Mu | PM |
| 10 | 1M | SW | GE | 1M,1Du | SW | GE | D | S,D | 12 | St | DP | Hyd | ..... | 315 | ..... | 2M,1T | GE | S | ..... | ..... | Mu | HT |
| 11 | 2M | SW | GE | 1M | SW | GE | D | S | 46 | St | DP | ..... | ..... | 315 | ..... | 2M,1T | GE | R | ..... | ..... | Mu | HT |
| 12 | 1M | SW | AC | N | ..... | ..... | V | ..... | N | ..... | ..... | ..... | ..... | 1 | IR | T | TE | S | 880 | ..... | Mu | COC |
| 13 | 2T | SW | WO | N | ..... | ..... | S,D | ..... | 14 | St | DP | ..... | ..... | 315 | WO | ..... | WO | R | 900 | ..... | Mu | PM |
| 14 | 1M | AS | GE | 1M | AS | GE | D | Hy | 14 | St | DP | ..... | ..... | 1 | IR | M | GE | R | ..... | ..... | ..... | ..... |
| 15 | 1T | CF | WE | 1T | CF | WE | S,D,V | S | 26 | St | DP | ..... | ..... | 2 | IR | 1M,1T | WE | R | ..... | ..... | Mu | IN |
| 16 | 1T | CF | TE | N | ..... | ..... | D | ..... | 1 | St | DP | ..... | ..... | 2 | ..... | M,T | EL | S,R | ..... | HLZ | ..... | ..... |
| 17 | 1M | CS | ..... | 1M | CS | ..... | V | D | 5 | St | DP | Me | ..... | 317 | BP | M,T | ..... | ..... | ..... | Z | ..... | ..... |
| 18 | 1Du | WE | WE | ..... | ..... | ..... | V | ..... | ..... | ..... | ..... | ..... | ..... | 1 | PP | M,T | WO,WE | R | 400 | CLZ | ..... | GW |
| 19 | 1T | CF | GE | N | ..... | ..... | D,V | ..... | 6 | St | DP | ..... | ..... | 1 | BP | T | GE | S | 1000 | ..... | De | COC |
| 20 | 1M | SW | WE | N | ..... | ..... | V | ..... | 2 | St | CV | ..... | ..... | 2 | PP | M | ..... | R | 50 | HL,HLZ | ..... | PM |
| 21 | 1M | CF | ..... | ..... | ..... | ..... | V | ..... | 2 | St | CV | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 35 | Z | ..... | PM |
| 22 | 1M | JH | ..... | 1M | JH | ..... | V | S,D | 8 | St | DP | Hyd | ASH | 2 | GJW | 1M,1T | BEE,GJW | ..... | ..... | Z | ..... | ..... |
| 23 | 1M | AS | ..... | ..... | ..... | ..... | V | ..... | 2 | St | DP | ..... | ..... | 217 | WO | T | WO | S | ..... | ..... | ..... | ..... |
| 24 | 1M | AS | AC | 1M | AS | AC | D | D | 16 | St | DP | Hyd | UC | ..... | ..... | T | GE | S | ..... | CLZ | ..... | ..... |
| 25 | 1T | BF | EL | 1T | BF | EL | ..... | ..... | ..... | St | DP | ..... | ..... | Ex | ..... | ..... | ..... | ..... | ..... | HLZ | ..... | ..... |
| 26 | 1M | PD | ..... | ..... | ..... | ..... | V | ..... | 1 | Air | DP | ..... | ..... | 216 | WO | ..... | ..... | ..... | 50 | Z | ..... | ES |
| 27 | 1T | ..... | WE | ..... | ..... | ..... | V | ..... | ..... | ..... | ..... | ..... | ..... | 215 | BP | T | WE | S | ..... | ..... | Mu | COC |
| 28 | 1T | AS | WE | 1T | AS | WE | S | S | ..... | St | DP | ..... | ..... | 215 | BP | T | WE | S | ..... | ..... | Mu | COC |
| 29 | ..... | ..... | ..... | 1M | PD | WEC | ..... | D | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 30 | 1M | AS | ..... | 1M | AS | ..... | V | S | 10 | Air | DP | ..... | ..... | Ex | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 31 | M | SW | GE | ..... | ..... | ..... | D | ..... | 4 | St | DP | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 32 | 1M | BF | GE | 1M | ..... | GE | ..... | D | 11 | St | DP | Pn | UC | 2 | IR | 1M,1T | GE | ..... | ..... | Z | ..... | ..... |
| 33 | 1M | BW | ..... | N | ..... | ..... | V | ..... | 2 | Air | DP | ..... | ..... | 118 | WO | ..... | ..... | ..... | ..... | CLZ | ..... | ..... |
| 34 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 219 | PP | M,T | AC,TE | S | 3000 | Z | ..... | ..... |
| 35 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 219 | PP | M,T | AC,TE | ..... | 3000 | Z | ..... | ..... |
| 36 | 1M | AS | AC | 1M | AS | AC | V | D | 10 | St | DP | Pn | UC | 1 | GP | M | AC | R | ..... | HLZ | ..... | COC |
| 37 | 2T | ..... | ..... | N | ..... | ..... | S,D | ..... | 3 | St | ..... | ..... | ..... | Ex | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 38 | 1M | FA | ..... | 1M | FA | ..... | V | D | 3 | St | DP | ..... | ..... | 1 | IR | M | ..... | R | ..... | Z | ..... | ..... |
| 39 | 1M | CF | EE | ..... | ..... | ..... | D | ..... | 2 | Air | DP | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 40 | 1M | AS | AC | ..... | ..... | ..... | V | ..... | 3 | Air | CV | ..... | ..... | 218 | DBP | ..... | ..... | ..... | ..... | Z | ..... | ..... |
| 41 | 1M | CF | GE | ..... | ..... | ..... | D | ..... | ..... | ..... | ..... | ..... | ..... | 116 | ..... | ..... | ..... | ..... | ..... | Z | ..... | ..... |
| 42 | 1M | ..... | ..... | ..... | ..... | ..... | V | ..... | ..... | ..... | ..... | ..... | ..... | 2 | ..... | M,T | ..... | ..... | 3600 | Z | ..... | ..... |
| 43 | 1T | CF | CT | 1T | CF | CT | S,D | D | 12 | St | DP | Pn | UC | 2 | WO | M,T | GE,MC | S,R | ..... | CLZ | ..... | COC |
| 44 | 1M | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1 | St | ..... | ..... | ..... | 1.5 | IR | M | ..... | ..... | ..... | ..... | ..... | ..... |
| 45 | 1M | AS | LA | ..... | ..... | ..... | D | ..... | ..... | ..... | ..... | ..... | ..... | 3 | WO | 2M,1T | LA,COP | R | 50 | ..... | Mu | PM |
| 46 | 1M | LJW | ..... | ..... | ..... | ..... | V | ..... | 2 | St | DP | ..... | ..... | 2 | PE | M,T | WE,COP | R | ..... | CLZ | ..... | GW |
| 47 | 1M | CF | WE | 1T | CF | WE | V | S | ..... | St | DP | ..... | ..... | 2 | BP | M,T | WE | R | 500 | CLZ | ..... | COC |
| 48 | 1M | CF | WE | 1T | CF | WE | V | S | 11 | St | DP | ..... | ..... | 2 | BP | M,T | WE | R | 500 | CLZ | ..... | COC |
| 49 | 1M | CF | WE | N | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1 | WPM | M | ..... | ..... | ..... | ..... | ..... | ..... |
| 50 | 1M | LJW | ..... | ..... | ..... | ..... | V | ..... | 4 | St | DP | ..... | ..... | 1 | WPI | M | ..... | R | ..... | ..... | ..... | ..... |
| 51 | 1Du | AS | EL | 1Du | AS | EL | D | D | 1 | St | DP | Pn | BB | ..... | ..... | ..... | ..... | ..... | 1000 | CLZ | ..... | ..... |
| 52 | 1T | CF | EL | 1T | CF | EL | D | D | 3 | St | CV | ..... | ..... | 2 | WO | M,T,Du | GE,EL | R | 150 | CLZ | ..... | ..... |
| 53 | M | SW | GE | 1M | SW | GE | ..... | V | ..... | ..... | CV | ..... | ..... | 1 | IR | 2M,1T | ..... | ..... | 50 | HLZ | ..... | AC |
| 54 | 1Du | AS | ..... | ..... | ..... | ..... | ..... | ..... | 4 | St | DP | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | CLZ | ..... | ..... |
| 55 | 1T | AS | CT | ..... | ..... | ..... | D | ..... | ..... | ..... | ..... | ..... | ..... | 1 | WS | T | TE | R | ..... | CLZ | ..... | ..... |
| 56 | 1T | FA | EL | 1T | PD | ..... | S | S | ..... | St | DP | Me | FE | 2 | AC | T | TE | S | ..... | ..... | ..... | ..... |
| 57 | 2 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 2 | IR | T | GE | ..... | ..... | HL | ..... | ..... |
| 58 | 1M | BF | ..... | ..... | ..... | ..... | V | ..... | 12 | St | CV | ..... | ..... | 1 | DL | T | DL | S | 500 | Z | ..... | ..... |
| 59 | 1M | CE | REC | ..... | ..... | ..... | V | ..... | ..... | ..... | ..... | ..... | ..... | 1 | ..... | M | AC | R | ..... | CLZ | ..... | ..... |
| 60 | 1M | AS | GE | 1M | AS | GE | V | D | N | ..... | ..... | Pn | UC | Ex | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 61 | 1M | GF | GE | ..... | ..... | ..... | D | ..... | 1 | St | DP | ..... | ..... | 1 | IR | M | GE | ..... | ..... | Z | ..... | ..... |
| 62 | 1M | AS | FM | ..... | ..... | ..... | V | ..... | 1 | St | DP | ..... | ..... | 1 | AM | M | LA | R | ..... | Z | ..... | ..... |
| 63 | 1M | PEC | US | N | ..... | ..... | V | ..... | 1 | Air | DP | ..... | ..... | 1716 | BJ | ..... | ..... | ..... | ..... | Z | Mi | ..... |
| 64 | 1M | AS | ..... | 1M | AS | ..... | V | D | 3 | St | DP | Pn | DUR | 2 | UP | 1M,1T | GE,TE | R | ..... | ..... | ..... | ..... |
| 65 | 1M | AS | RE | 1M | AS | RE | V | D | 5 | St | DP | Pn | BB | ..... | ..... | ..... | ..... | ..... | 400 | HLS | ..... | ..... |
| 66 | 1M | GF | FM | N | ..... | ..... | D | ..... | 2 | St | DP | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 67 | 1M | CF | ..... | N | ..... | ..... | V | ..... | 2 | St | DP | ..... | ..... | 2 | IR | M | ..... | ..... | 50 | Z | ..... | PM |
| 68 | 1M | ..... | ..... | ..... | ..... | ..... | V | ..... | 1 | St | DP | ..... | ..... | 2 | JA | M | ..... | R | ..... | Z | ..... | ..... |
| 69 | 1M | AL | FM | ..... | ..... | ..... | D | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | CLZ | ..... | ..... |
| 70 | 1M | CF | EL | 1M | CF | EL | D | D | 5 | St | DP | ..... | ..... | 2 | ..... | M,T | ..... | ..... | ..... | ..... | ..... | ..... |
| 71 | 1Du | FA | GE,CT | ..... | ..... | ..... | S,V | ..... | 8 | St | DP | Me | ASH | 1 | WPI | M,T | EM,CT | R | ..... | ..... | ..... | ..... |

FI - Frederick Iron & Steel, Inc
FM - Fairbanks, Morse & Co
FX - The Foxboro Co
GE - General Electric Co
GF - Green Fuel Economizer Co Inc
GJW - G & J Weir, Ltd
GP - Goulds Pumps, Inc
GW - Graver Water Conditioning Co
HCC - Hagan Chemicals & Controls, Inc
HR - Hewitt-Robins, Inc
HT - Hungerford & Terry, Inc

IN - Infilco, Inc
IR - Ingersoll-Rand Co
JA - Jacuzzi Bros, Inc
JH - James Howden & Co Ltd
K - E Keeler Co
KC - Koppers Co, Inc
LA - Louis-Allis Co
LB - Link-Belt Co
LC - Lecourtney Co
LJW - L J Wing Mfg Co
MC - Moore Co

MCC - Marietta Concrete Co
MH - Minneapolis-Honeywell Regulator Co
MI - Murray Iron Works Co
MP - Mayer Pollock, Inc
MWK - M W Kellogg Co
NA - National Aluminate Co
PD - Prat-Daniel Corp
PE - Peerless Pump Div, Food Machinery and Chemical Corp
PEC - Peabody Engineering Corp

PM - Permutit Co Div of Pfaudler Permutit, Inc
PP - Pacific Pumps, Inc
RC - Research-Cottrell, Inc
RCL - Research-Cottrell, Ltd
RE - Reliance Electric & Engrg Co
REC - Rauland Electric Co
RF - Republic Flow Meters Co
RS - Riley Stoker Corp
RV - Robinson Ventilating Co

SA - Stephens-Adamson Mfg Co
SB - Sauerman Bros Inc
SE - Stock Equipment Co
SW - Sturtevant Div, Westinghouse Electric Corp
TE - Terry Steam Turbine Co
UC - United Conveyor Corp
UI - Union Iron Works
UP - Union Steam Pump Co
US - U S Electrical Motors Inc

Compiled by: T W Edwards, Associate Editor and Althea Thornton

| Combustion control | Control manufacturer | TURBINES | | | | | | | | | | | | CONDENSERS | | | | | Boiler controls | Total plant boiler capacity incl new units, 1000 lb per hr | Project Number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number | Throttle pressure, psig | Throttle temperature, F | Manufacturer | Capacity, kw | Type | Rpm | Back pressure, psia | No. of bleed points | No. of auto-extraction points | Deaerating heater pressure, psig | Generator cooling | Type | Manufacturer | No. of water passes | Cooling water source | Condensate air removal | | | |
| ..... | ..... | 1 | 1250 | 950 | GE | 60,000 | AE | ..... | ..... | ... | ... | ..... | ..... | Su | WO | 2 | River | J | ..... | ..... | 1 |
| Pn | ..... | 1 | 1250 | 900 | GE | 40 | NC, AE | 3600 | 20 | ... | 1 | 10 | $H_2$ | ..... | ..... | ... | ..... | ... | Dec | ..... | 2 |
| Pn | HCC | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | ..... | 3 |
| Pn | BM | 1 | 1225 | 880 | WE | 25,000 | Con, AE | 3600 | 1.25 | 2 | 2 | 50 | $H_2$ | Su | YU | 2 | CT | J | Dec | 450 | 4 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | Dec | 450 | 5 |
| Pn | BM | 2 | 900 | 850 | AC | 6000 | NC | 3600 | 225 | ... | ... | 15 | Air | Su | WE | 2 | CT | J | Cen | 220 | 6 |
| | | | 210 | 650 | WE | 7500 | Con | 3600 | 14 | 3 | ... | | | | | | | | | | |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 1500 | 7 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 662 | 8 |
| Hyd | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | Dec | 805 | 9 |
| E | FX | 1 | 850 | 900 | GE | 30,000 | Con, AE | 3600 | 1.25 | ... | 2 | 50 | $H_2$ | Su | IR | 2 | River | J | Con | 907 | 10 |
| E | FX | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | Con | 907 | 11 |
| Pn | BM | 1 | 725 | 740 | WE | 5 | NC, AE | 3600 | 240/30 | ... | 2 | 7 | Air | ..... | ..... | ... | ..... | ... | Con | 700 | 12 |
| Pn | BM | N | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | Con | 5100 | 13 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | ..... | 14 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | ..... | 15 |
| ..... | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | Dec | 40 | 16 |
| Pn | BM | 1 | 750 | 600 | CGE | 25,000 | NC, AE | 3600 | 65 | ... | 1 | 46 | Air | ..... | ..... | ... | ..... | ... | Dec | 1180 | 17 |
| Pn | RF | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 350 | 18 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 1470 | 19 |
| Pn | BM | 1 | 575 | 650 | DL | 1000 | NC | 5400 | 110 | N | N | 5 | Air | N | ..... | ... | ..... | ... | Cen | 100 | 20 |
| E | PEC | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 72 | 21 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | Cen | 800 | 22 |
| Pn | BM | 1 | 400 | 750 | WE | 2500 | Con, AE | 3600 | ..... | ... | 1 | ..... | Air | Su | WE | 4 | River | J | Dec | 175 | 23 |
| Pn | HCC | 1 | 400 | 580 | DL | 7500 | NC | 3600 | 165 | ... | ... | ..... | Air | ..... | ..... | ... | ..... | ... | Cen | 620 | 24 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | ..... | 25 |
| Hyd | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 45[2] | 26 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 850 | 27 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 850 | 28 |
| ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | ..... | 29 |
| Pn | HCC | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 700 | 30 |
| ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 480 | 31 |
| ..... | BM | 1 | 400 | 600 | GE | 3000 | NC | 3600 | 15 | ... | ... | ..... | Air | ..... | ..... | ... | ..... | ... | ..... | 180 | 32 |
| Hyd | RF | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 300[2] | 33 |
| Pn | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | Cen | 500 | 34 |
| Pn | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | Cen | 500 | 35 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 190 | 36 |
| Pn | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 440 | 37 |
| E | HC | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 60 | 38 |
| Pn | HCC | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | Cen | 120[2] | 39 |
| Pn | HC | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 60[2] | 40 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 60[2] | 41 |
| E | MH | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 35 | 42 |
| Pn | HCC | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 220 | 43 |
| E | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 54 | 44 |
| Pn | HCC | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 165 | 45 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 50 | 46 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | Cen | 480 | 47 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | Cen | 480 | 48 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 60 | 49 |
| ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | ..... | 50 |
| Pn | HCC | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 570 | 51 |
| Pn | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | Cen | 850 | 52 |
| Pn | ..... | 2 | ..... | ..... | WO | 500 | NC | 5500 | ..... | ... | ... | 3 | Air | ..... | ..... | ... | ..... | ... | Dec | 100 | 53 |
| ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | ..... | 54 |
| ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 140 | 55 |
| Pn | CV | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | Cen | 370 | 56 |
| ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | ..... | 57 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 200 | 58 |
| Pn | CC | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 15 | 59 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | Dec | 300 | 60 |
| Pn | ..... | 1 | 235 | Sat | WE | 500 | NC | ..... | 25 | ... | ... | 10 | Air | ..... | ..... | ... | ..... | ... | ..... | 28 | 61 |
| Pn | RF | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 96 | 62 |
| Pn | HCC | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 66[2] | 63 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 103 | 64 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 360 | 65 |
| Pn | BM | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 90 | 66 |
| E | PEC | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | ..... | 67 |
| Pn | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 207 | 68 |
| Pn | ECA | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | 41 | 69 |
| Pn | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ... | ..... | ... | ..... | ..... | 70 |
| Pn | HCC, CV | 3 | 190 | 460 | GE | 1500 | NC | 3600 | 18 | ... | ... | 10 | Air | N | ..... | ... | ..... | ... | Dec | 340 | 71 |

VO - Henry Vogt Machine Co
WE - Westinghouse Electric Corp
WEC - Wagner Electric Corp
WI - Wickes Boiler Co
WO - Worthington Corp
WP - Western Precipitation Corp
WPI - Warren Pumps, Inc
WS - Wilson-Snyder Works, U S Steel Corp
WM - Webster Mfg, Inc
YU - Yuba Heat Transfer Div

SYMBOLS USED ABOVE

AE - Auto-extraction
Can - Centralized
CLZ - Cold lime zeolite
Con - Condensing
CT - Cooling tower
D - Damper
De - Demineralizer
Dec - Decentralized
Du - Dual drive
E - Electrical
Ex - Existing
$H_2$ - Hydrogen
HL - Hot lime
HLS - Hot lime soda
HLZ - Hot lime zeolite
Hy - Hydraulic coupling
Hyd - Hydraulic
J - Steam jet
M - Motor
Me - Mechanical
Mi - Mixed bed
Mu - Multibed
N - None
NC - Noncondensing
Pn - Pneumatic
R - Regulator
S - Speed
Sat - Saturated
So - Softening
St - Steam
Su - Surface
T - Turbine
V - Vane
Z - Zeolite
15 - For 2 boilers
16 - High temperature water district pumps
17 - For 5 boilers
18 - High temperature water circulating pumps
19 - For 22 boilers

# Table 2 1961 design survey: typical industrial,

| Project Number | Company & Location | Consulting Engineers | New or existing plant | Date of initial operation | Principal steam use | NEW BOILERS: Number new boilers | Manufacturer | Operating pressure, psig | Operating temperature, F | Boiler type | Capacity each, 1000 lb per hr | Boiler and waterwall surface, 1000 sq ft | Furnace volume 1000 cu ft | Furnace heat release, 1000 Btu per cu ft per hr | Furnace type | NEW FIRING EQUIPMENT: Firing method | Manufacturer | Fuel type | Heating value 1000 Btu per lb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **200 TO 181 PSIG** | | | | | | | | | | | | | | | | | | | |
| 72 | American Biltrite Rubber Co, Trenton, N J | H M Wilson Co, Inc | Ex | 1960 | Pr | 1 | WI | 200 | Sat | WT | 35 | 4.3 | 1.1 | ..... | Pd | Rog | ..... | O | ..... |
| 73 | Great Lakes Chemical Corp, El Dorado, Ark | Cummins & Barnard, Inc | New | 1961 | Pr | 1 | K | 200 | Sat | WT | 35 | 3.9 | 1.0 | 44.2 | Pd | Rog | ..... | G | 1000[1] |
| 74 | Hoague-Sprague Corp, West Hopkinton, N H | Anderson-Nichols Co, Inc | Ex | 1961 | Pr | 1 | BW | 200 | Sat | WT | 30 | 4.2 | ..... | ..... | ..... | Br | ..... | O | 18.5 |
| 75 | Princeton University, Princeton, N J | Meyer, Strong, Jones | New | 1961 | Po, SH | 1 | UI | 200 | 430 | WT | 80 | 7.6 | 3.4 | 110 | BD | VG | DSC | C | ..... |
| 76 | New York & Pennsylvania Co, Lock Haven, Pa | H M Wilson Co, Inc | Ex | 1961 | Po, Pr | 1 | EC | 190 | 550 | WT | 125 | 16.4 | 6.7 | 29.4 | BD | VG | AE | C | 13.4 |
| 77 | Sears, Roebuck & Co, Philadelphia, Pa | H M Wilson Co, Inc | Ex | 60-61 | SH | 4 | K | 190 | 430 | WT | 40 | 5.8 | 2.1 | 25 | BD | Rog | ..... | G, O | 1030[1] |
| 78 | Wabash Fibre Box Co Div, Ft Wayne, Ind | Neilson Engineering | New | ..... | Pr, SH | 1 | SCI | 190 | Sat | WT | 13 | 1.4 | 0.3 | ..... | BD, DB | Rog, RC | ..... | O, G | ..... |
| 79 | Allied Chemical Corp, Brunswick, Ga | | Ex | 9-60 | Pr | 1 | BW | 185 | 385 | WT | 30 | 3.6 | 1.0 | ..... | Pd | Br | ..... | O | ..... |
| 80 | Allied Chemical Corp, Moundsville, W Va | | Ex | 2-61 | Pr | 1 | BW | 160 | Sat | WT | 100 | 11.5 | ..... | ..... | ..... | CDS | DSC | C | 13 |
| 81 | Interchemical Corp, Hawthorne, N J | | Ex | 1961 | Pr | 1 | BW | 185 | Sat | WT | 43 | 3.6 | 0.9 | ..... | Pd | Br | ..... | O | ..... |
| 82 | St James Sugar Cooperative Inc, St James, La | Arthur G Keller | .... | ..... | ..... | 1 | CE | 185 | Sat | WT | 50[7] | 7.6 | ..... | 29.4 | BD | ..... | ..... | Ba, G | 4.1 |
| 83 | Solar Nitrogen Co, Joplin, Mo | | New | 1961 | Pr | 2 | MI | 185 | Sat | WT | 55 | ..... | ..... | ..... | ..... | Rog | ..... | O, G | ..... |
| **180 TO 161 PSIG** | | | | | | | | | | | | | | | | | | | |
| 84 | E I DuPont de Nemours & Co, Florence, S C | | New | 12-60 | SH | 2 | CE | 175 | Sat | WT | 40 | 3.5 | ..... | 55 | Pd | Br | ..... | O, G | ..... |
| 85 | Minde & Dauch, Moncton, N B | Foundation Co of Canada | New | 1961 | Pr | 2 | CB | 175 | Sat | FT | 4.9 | ..... | ..... | ..... | ..... | Br | ..... | O | 18.3 |
| 86 | Putnam Herzl Finishing, Putnam, Conn | Andrew Martin | Ex | 1961 | Pr | 1 | BW | 175 | Sat | WT | 26 | 2.9 | 0.8 | ..... | BD | Rog | ..... | O | ..... |
| 87 | Container Corp of America, Seattle, Wash | | Ex | 10-59 | Pr | 1 | BW | 170 | Sat | WT | 15 | 1.5 | 0.4 | 46 | Pd | Br | ..... | G, O | ..... |
| 88 | Container Corp of America, Fresno, Calif | | Ex | 10-59 | Pr | 1 | BW | 170 | Sat | WT | 15 | 1.5 | 0.4 | 46 | Pd | Br | ..... | G, O | ..... |
| 89 | R J Reynolds Tobacco Co, Winston-Salem, N C | Stone & Webster Engrg Corp | New | ..... | Pr | 3 | UI | 170 | Sat | WT | 100 | 8.3 | 4.1 | 28.4 | ..... | CDS | DSC | C | 12.8 |
| 90 | Carnation Co Ltd, Wetaskiwin, Alta | | New | 1962 | Pr | 2 | BWG | 165 | Sat | WT | 20 | 2.4 | 0.5 | 49.5 | DB, Pd | Br | ..... | G | 1000[1] |
| 91 | Ford Motor Co, Highland Park, Mich | Dravo Corp | New | 7-58 | Pr, SH | 4 | K | 165 | Sat | WT | 50 | 5.9 | 1.3 | 50 | Pd | Br | ..... | O, G | ..... |
| 92 | Revere Sugar Refinery, Charlestown, Mass | | Ex | 5-60 | Pr | 1 | CE | 165 | Sat | WT | 85 | 6.2 | 2.4 | 31 | BD | Cy | ..... | O | ..... |
| 93 | United Rubber & Chemical Co, Bay Town, Texas | | Ex | 1961 | Pr | 1 | UI | 165 | 473 | WT | 60 | 5.4 | 1.3 | 60.4 | Pd | Rg | ..... | G | 1060[1] |
| **160 TO 141 PSIG** | | | | | | | | | | | | | | | | | | | |
| 94 | American Motors Corp, Kenosha, Wis | Vern E Alden Co | New | 1960 | Pr, SH | 3 | WI | 160 | Sat | WT | 60 | 5.8 | 1.2 | 65.5 | BD | Br | ..... | O, G | 19.5 |
| 95 | Magee Carpet Co, Bloomsburg, Pa | H M Wilson Co, Inc | Ex | 1961 | Pr | 1 | K | 160 | 475 | WT | 62 | 7.7 | 3.1 | 36 | BD | BKE | CE | An | 11.3 |
| 96 | Spaldings Laundry & Dry Cleaning, Louisville, Ky | | Ex | 1961 | Po, Pr | 1 | VO | 160 | Sat | WT | 40 | ..... | ..... | ..... | ..... | CG | LS | ..... | ..... |
| 97 | Springday Co, Springfield, Mo | | Ex | ..... | ..... | ... | K | 160 | Sat | WT | 31 | 3.4 | ..... | ..... | Pd | Rog | ..... | O, G | ..... |
| 98 | Sweets Co of America, Hoboken, N J | | Ex | ..... | Pr | 2 | BW | 155 | Sat | WT | 30 | ..... | ..... | ..... | Pd | Rog | ..... | O | ..... |
| 99 | Barton Distilling, Bardstown, Ky | | .... | 1961 | Pr | 1 | VO | 150 | Sat | WT | 75 | ..... | ..... | ..... | ..... | CDS | DSC | C | ..... |
| 100 | Bay State Abrasive Products Co, Westboro, Mass | K Worrington | Ex | 1961 | Pr, SH | 1 | RS | 150 | Sat | WT | 30 | 3.0 | 1.0 | 36.1 | BD | Ro | ..... | O | ..... |
| 101 | Beloit Iron Works, Beloit, Wis | W Fred Dolke | New | 1961 | Po, Pr | 2 | CB | 150 | Sat | WT | 5.2 | ..... | ..... | ..... | ..... | Br | ..... | G | ..... |
| 102 | Canadian Oil Companies Ltd, Bowden, Alta | Canadian Bechtel Corp | New | 1960 | Pr | 2 | BT | 150 | Sat | FT | 10 | 1.5 | 0.2 | 74.5 | Pd | Rog | ..... | O, G | 19.0 |
| 103 | E I DuPont de Nemours & Co, Parlin, N J | Self | Ex | 8-60 | Pr | 2 | CE | 150 | Sat | WT | 60 | 4.3 | 1.2 | 63.1 | Pd | Br | ..... | O | 18.3 |
| 104 | Field Packing Co, Owensboro, Ky | A M Kinney, Inc | Ex | 8-59 | Pr | 1 | CE | 150 | 410 | WT | 27 | 4.5 | 1.0 | 33.5 | BD | DGS | CE | C | ..... |
| 105 | Ford Motor Co of Canada Ltd, Niagara Falls, Ont | Giffels & Vallet | New | 1961 | Pr, SH | 2 | BW | 150 | Sat | FT | 30 | 4.0 | 0.8 | ..... | Pd | Rog | ..... | O, G | 18 |
| 106 | Hunt Foods & Industries, Inc, Davis, Calif | C C Moore & Co | New | 1961 | Pr | 2 | BW | 150 | Sat | WT | 100 | 10 | ..... | ..... | ..... | Rog | ..... | O, G | ..... |
| 107 | Hunt Foods & Industries, Inc, Hayward, Calif | C C Moore & Co | New | 8-60 | Pr | 1 | BW | 150 | Sat | WT | 85 | 8.5 | ..... | ..... | BD | Br | ..... | G | 1050[1] |
| 108 | Kendall Co, Franklin, Ky | | New | ..... | Pr, SH | 2 | CB | 150 | Sat | FT | 7 | 1.1 | ..... | 7.0 | ..... | Br | ..... | G | ..... |
| 109 | Mansfield Reformatory, Mansfield, Ohio | Ronald Berger | Ex | 1961 | Po | 1 | UI | 150 | Sat | WT | 90 | 13.1 | ..... | ..... | BD | BKE | RS | C | 14.3 |
| 110 | Monadnock Paper Mill, Bennington, N H | | Ex | ..... | ..... | 2 | BW | 150 | Sat | WT | 30 | ..... | ..... | ..... | Pd | Br | ..... | O | ..... |
| 111 | Reynolds Metals Co, McCook, Ill | Vern E Alden Co | Ex | 9-60 | SH | 1 | BW | 150 | Sat | WT | 50 | ..... | 1.6 | ..... | Pd | Br | ..... | O, G | ..... |
| 112 | St Louis-San Francisco Ry Co, Springfield, Mo | | New | 1961 | SH, Pr | 2 | K | 150 | Sat | WT | 55 | 5.4 | 1.2 | 53.6 | Pd | Rog | ..... | G, O | 1080[1] |
| 113 | Schenley Distillers Inc, Gethsemane, Ky | Elliston, Hall, McAllister & Stockwell | Ex | 1961 | Pr, SH | 1 | BW | 150 | Sat | WT | 31 | 4.3 | 1.2 | 35.0 | BD | DGS | DSC | C | 12.5 |
| 114 | Shannon West Texas Mem Hospital, San Angelo, Texas | Tippett & Gee | Ex | 1961 | Pr, SH | 2 | BW | 150 | Sat | WT | 25 | ..... | 0.8 | 40.7 | BD | Rog | ..... | ..... | ..... |
| 115 | Wilco Chemical Co, Forest View, Ill | | Ex | 1961 | Pr, SH | 1 | BW | 150 | Sat | WT | 50 | 4.0 | ..... | ..... | ..... | Rog | ..... | O, G | ..... |
| 116 | Jacques Wolf & Co, Caristadt, N J | | Ex | 9-60 | Pr | 1 | CE | 150 | Sat | WT | 60 | 3.9 | 1.1 | 63.3 | Pd | Br | ..... | O | ..... |
| **140 TO 121 PSIG** | | | | | | | | | | | | | | | | | | | |
| 117 | Hoffman-La Roche Inc, Nutley, N J | Self | Ex | 1961 | Pr | 1 | CE | 140 | Sat | WT | 100 | 6.2 | 2.4 | ..... | DB, Pd | Rog | ..... | O | 18.5 |
| 118 | Lance, Inc, Charlotte, N C | J N Pease & Co | New | 1962 | Pr, SH | 2 | BW | 140 | Sat | WT | 22 | 2.4 | 0.6 | 50 | Pd | Rog | ..... | O, G | ..... |
| 119 | Albany Hospital, Albany, N Y | Schmidt, Garden & Erikson | Ex | ..... | ..... | 2 | CE | 135 | Sat | WT | 35 | 5.0 | ..... | ..... | BD | Br | ..... | O | ..... |
| 120 | American Motors Corp, Kenosha, Wis | Giffels & Rossetti | Ex | 1960 | Pr, SH | 2 | WI | 135 | 410 | WT | 90 | 10.8 | 4.2 | 26.4 | Pd | CDS | RS | C | 12.0 |
| 121 | Massachusetts Mutual Life Ins Co, Springfield, Mass | Cleverdon, Varney and Pike | Ex | 1961 | Pr, SH | 2 | BW | 135 | Sat | WT | 22.5 | 2.7 | 0.7 | ..... | Pd | Ro | ..... | O | 13.7 |
| 122 | Calif State Polytechnic College, San Luis Obispo, Calif | Div of Arch, State of Calif | Ex | 1961 | Pr, SH | 1 | K | 130 | Sat | WT | 20 | 2.5 | ..... | ..... | BD | Rog | ..... | O, G | ..... |
| 123 | Southwest Texas Methodist Hospital, San Antonio, Texas | George Rhine & Co | New | ..... | SH, Po[10] | 2 | K | 130 | Sat | ..... | 34 | ..... | ..... | ..... | ..... | Rog | ..... | O, G | ..... |
| 124 | Chas Todd Uniform Rental Ser Co, St Louis, Mo | | Ex | 1961 | Pr, SH | 1 | CE | 130 | Sat | WT | 24 | 2.2 | ..... | ..... | DB, Pd | Rog | ..... | O, G | ..... |
| 125 | Union Carbide Canada Ltd, Lindsay, Ont | | ... | 1961 | Pr, SH | 1 | BW | 130 | Sat | WT | 35 | 4.3 | 1.5 | 30.3 | BD | CDS | DSC | C | 14 |
| 126 | Merck Sharp & Dohme, West Point, Pa | | Ex | 1961 | Pr, SH | 1 | EC | 129 | Sat | WT | 80 | 9.5 | 3.2 | ..... | BD | Br | ..... | O | 18 |
| 127 | Central Michigan University, Mt Pleasant, Mich | Russell Voght | New | 1961 | SH | 2 | WI | 126 | Sat | WT | 75 | 7.2 | ..... | 60 | ..... | Rog | ..... | O, G | ..... |
| 128 | Avco Corp, New Idea Div, Coldwater, Ohio | Fosdick & Hilmer | Ex | 1960 | SH | 2 | CE | 125 | Sat | WT | 36.5 | 3.4 | 0.9 | 49.6 | Pd | Br | ..... | O | ..... |
| 129 | Beaunit Mills Inc, Lowell, N C | | Ex | ..... | Pr | 1 | K | 125 | 550 | WT | 60 | ..... | ..... | ..... | ..... | Rog | ..... | O, G | ..... |
| 130 | Board for Texas State Hospitals, Mexia, Texas | Nelson Miner & Co | Ex | 1961 | Pr, SH | 1 | K | 125 | Sat | WT | 27 | 3.5 | 0.8 | 43.5 | Pd | Rg | ..... | G | 1040[1] |

**SYMBOLS USED ABOVE**

An - Anthracite
At - Steam assisted mechanical atomizing
Ba - Bagasse
BD - Balanced draft
BE - Bucket Elevator
Be - Belt
BKE - Bar and key stoker
Br - Burner
C - Coal, bituminous
CBS - Continuous discharge spreader stoker
CG - Chain grate stoker
CLZ - Cold lime zeolite
Cy - Cyclone
D - Damper
DB - Dry bottom
De - Demineralizer
DGS - Dump grate spreader stoker
Du - Dual Drive
E - Electrical
Ex - Existing plant or equipment
Fl - Flight
FT - Fire tube
G - Gas
HLS - Hot lime soda
HLZ - Hot lime zeolite
Hyd - Hydraulic
M - Motor
Ma - Magnetic coupling
Mu - Mechanical
Mi - Mixed bed demineralizer
Mu - Multibed demineralizer
N - None
O - Oil
PC - Pulverized coal
Pd - Pressurized
Pn - Pneumatic
Po - Power
Pr - Process
R - Regulator
RC - Rotary cup burner
Rg - Register oil burner
Ro - Register oil burner
Rog - Register oil-gas burner
Rp - Reciprocating steam
RR - Railroad
S - Speed
Sat - Saturated
SC - Stacking conveyor
SH - Space heat
So - Softening
SR - Single retort underfeed stoker
St - Steam
Sto - Stoker
Sw - Screw conveyor
T - Turbine
Tr - Truck
V - Vane
VG - Vibrating grate
WT - Water tube
WW - Wood waste
Z - Zeolite softening
1 - Btu per cu ft
2 - For 2 boilers
3 - For all boilers
4 - Million Btu per hr
5 - High temperature water
6 - High temperature water circulating pumps
7 - On bagasse; 60,000 lb per hr on gas
8 - For 4 boilers
9 - For 3 boilers
10 - 2 turbines, 500 kw each

**MANUFACTURERS**

AC - Allis-Chalmers Mfg Co
AE - American Engineering Co
AL - Aladdin Heating Corp
AM - American Marsh Pumps, Inc
APr - Air Preheater Corp
AS - American Standard, Ind Div
ASH - Allen-Sherman-Hoff Co
ASL - AS Leitch
AU - Aurora Pump Div
AWC - A W Cash Co
BA - The Bayer Co
BAC - Bird-Archer Co
BC - Bepco Canada Ltd
BE - Betz Laboratories, Inc
BEC - Baldor Electric Co
BF - Buffalo Forge Co
BJ - Byron Jackson Pumps, Inc

# institutional plants, 200 psig and below

| COAL HANDLING EQUIPMENT | | | | F. D. FANS | | | I. D. FANS | | | AIR & GAS FLOW CONTROL | | SOOT BLOWERS | | | | FEED WATER PUMPS | | | | | WATER TREATMENT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Delivery method to plant site | Stockpile to in-plant storage | In-plant handling equipment | Manufacturer | No. and drive | Fan manufacturer | Drive manufacturer | No. and drive | Fan manufacturer | Drive manufacturer | Air flow | Gas flow | No. per boiler | Type | Manufacturer | Ash handling system | Number per boiler | Pump manufacturer | Drive type | Drive manufacturer | Pump control | Type | Manufacturer | Combustion control | Control manufacturer | Total plant boiler capacity 1000 lbs per hr | Project Number |
| ..... | ..... | ..... | ..... | 1M | RV | ..... | ..... | ..... | ..... | D | ..... | 4 | St | CV | ..... | 2 | FI | M | WE | ..... | CLZ | ..... | E | WI | 50 | 72 |
| ..... | ..... | ..... | ..... | 1M | AL | LA | N | ..... | ..... | D | ..... | ..... | ..... | ..... | ..... | 2 | DHP | M,T | RE,DHP | R | ..... | ..... | E | CC | 35 | 73 |
| ..... | ..... | ..... | ..... | 1T | ..... | ..... | N | ..... | ..... | S | ..... | 4 | St | DP | ..... | 1 | ..... | T | ..... | ..... | ..... | ..... | E | ECA | 60 | 74 |
| RR | Be | Be,BE | HR | 1M | AS | GE | 1M | AS | GE | V | D | 6 | St | DP | Pn | 2 | LC | T | EL | R | CLZ | ..... | ..... | ..... | 190 | 75 |
| ..... | ..... | ..... | ..... | 1M | BF | AC | 1T | BF | WE | V | S | 4 | St | DP | Ex | Ex | ..... | ..... | ..... | ..... | ..... | ..... | Pn | HCC | 500 | 76 |
| ..... | ..... | ..... | ..... | 1M | LJW | RE | N | ..... | ..... | V | ..... | 3 | St | DP | ..... | Ex | ..... | ..... | ..... | ..... | CLZ | ..... | E | HC | 160 | 77 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | ..... | ..... | ..... | D | ..... | 2 | St | BA | ..... | 1 | ..... | M | ..... | ..... | CLZ | ..... | ..... | ..... | 13 | 78 |
| ..... | ..... | ..... | ..... | 1M | GF | ..... | N | ..... | ..... | V | ..... | 2 | St | DP | ..... | 1 | ..... | ..... | ..... | ..... | HLZ | ..... | Pn | BM | 120 | 79 |
| RR | Be,BE | ..... | ..... | 1M | SW | WE | 1M | ..... | WE | D | D | 5 | St | DP | Me | 1 | IR | T | WMC | R | So | ..... | Pn | BM | 220 | 80 |
| ..... | ..... | ..... | ..... | 1M | CF | LA | N | ..... | ..... | V | ..... | 2 | St | DP | ..... | 1 | DL | M | LA | R | Z | ..... | E | ..... | 85 | 81 |
| ..... | ..... | ..... | ..... | 1T | LJW | LJW | 1T | FA | TE | S | ..... | ..... | St | DP | ..... | 2[8] | ..... | T | TE | S | ..... | ..... | Pn | RF | 180 | 82 |
| ..... | ..... | ..... | ..... | 1T | ..... | ..... | ..... | ..... | ..... | S | ..... | ..... | ..... | ..... | ..... | 3[2] | ..... | M,T | ..... | ..... | Z | ..... | ..... | ..... | ..... | 83 |
| ..... | ..... | ..... | ..... | 1T | AL | TE | N | ..... | ..... | D,V | ..... | 1 | St | CV | ..... | 1 | IR | T | TE | S | Z | ..... | E | CC | 80 | 84 |
| ..... | ..... | ..... | ..... | .... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 2 | ASL, DBL | M | ..... | R | ..... | DCC | E | ..... | 12 | 85 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | ..... | ..... | ..... | D | ..... | 1 | St | DP | ..... | 2 | GP | M,T | COP | R | CLZ | ..... | E | BM | 56 | 86 |
| ..... | ..... | ..... | ..... | 1M | AL | FM | N | ..... | ..... | D | ..... | 1 | ..... | DP | ..... | 1 | WO | ..... | WE | R | ..... | ..... | E | CC | 15 | 87 |
| ..... | ..... | ..... | ..... | 1M | AL | FM | N | ..... | ..... | D | ..... | 1 | ..... | DP | ..... | 1 | WO | ..... | WE | R | Z | ..... | E | CC | 15 | 88 |
| RR | Be,SC | Sw | SA | 1Du | BF | GE,EL | 1Du | GF | GE,EL | V | D | ..... | ..... | ..... | Pn | 1[9] | IR | M,T | GE,EL | S | CLZ | HT | Pn | BM | 300 | 89 |
| ..... | ..... | ..... | ..... | 1M | CF | ..... | ..... | ..... | ..... | D | ..... | N | ..... | ..... | ..... | 1 | BWG | M | ..... | R | Z | ..... | ..... | ..... | 40 | 90 |
| ..... | ..... | ..... | ..... | 1M | CF | ..... | N | ..... | ..... | D,V | ..... | 2 | St | DP | ..... | 3[8] | DL | 2T,1M | TE,ED | S | So | ..... | Pn | RF | 200 | 91 |
| ..... | ..... | ..... | ..... | 1M | FA | GE | 1M | FA | GE | V | D | 3 | St | CV | ..... | 1 | IR | T | GE | S | So | ..... | Pn | HCC | 370 | 92 |
| ..... | ..... | ..... | ..... | 1M | CF | LA | ..... | ..... | ..... | V | ..... | N | ..... | ..... | ..... | Ex | ..... | ..... | ..... | ..... | ..... | ..... | Pn | BM | 150 | 93 |
| ..... | ..... | ..... | ..... | 1Du | ..... | HEM, COP | N | ..... | ..... | D | ..... | ..... | ..... | ..... | ..... | 2[0] | WO | M,T | HEM, DHP | R | CLZ | AC | E | CCI | 180 | 94 |
| Tr | Be | Be,BE | LB | 1Du | AS | ..... | 1Du | BF | ..... | D | S | 4 | St | CV | Pn | Ex | ..... | ..... | ..... | ..... | ..... | ..... | Pn | BM | 200 | 95 |
| Tr | Be,Sw | Be,Sw | ..... | 1M | BF | GE | 1M | BF | GE | D | D | 3 | St | DP | ..... | 1 | IR | M | GE | R | ..... | ..... | ..... | ..... | 60 | 96 |
| ..... | ..... | ..... | ..... | 1M | FM | ..... | ..... | ..... | ..... | ..... | ..... | 1 | St | DP | ..... | 1[2] | AU | T | COP | R | Z | ..... | Pn | CC | 58.7 | 97 |
| ..... | ..... | ..... | ..... | M | ..... | ..... | N | ..... | ..... | D | ..... | 1 | St | ..... | ..... | 3[2] | ..... | M,Du | ..... | ..... | ..... | ..... | Hyd, Pn | ..... | 60 | 98 |
| ..... | ..... | ..... | ..... | 1M | AS | WE | N | ..... | ..... | S,D | ..... | 8 | St | DP | ..... | 1 | PPD | M | WE | Mo | ..... | ..... | ..... | BM | 120 | 99 |
| ..... | ..... | ..... | ..... | 1M | CF | ..... | ..... | ..... | ..... | ..... | ..... | 4 | St | DP | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Pn | HCC | 30 | 100 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1 | AU | M | ..... | ..... | Z | COC | ..... | ECA | ..... | 101 |
| ..... | ..... | ..... | ..... | 1M | WA | GE | ..... | ..... | ..... | D | ..... | 1 | St | ..... | ..... | 1 | BJ | M | WE | ..... | Z | ..... | E | ECA | 20 | 102 |
| ..... | ..... | ..... | ..... | 1T | CF | TE | N | ..... | ..... | D | ..... | 2 | ..... | DP | ..... | 1 | IR | T | TE | ..... | Z | ..... | E | CC | 200 | 103 |
| Tr | ..... | ..... | ..... | 1M | GF | ..... | ..... | ..... | ..... | V | ..... | 3 | ..... | CV | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Pn | HCC | 54 | 104 |
| ..... | ..... | ..... | ..... | 1M | CF | GE | ..... | ..... | ..... | V | ..... | 1 | St | DP | ..... | 2 | DBL | M,T | CT | S,R | CLZ | BAC | Pn | BM | 60 | 105 |
| ..... | ..... | ..... | ..... | 1M | ..... | US | 1M | AL | US | ..... | ..... | 1 | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | HLZ | ..... | ..... | ..... | 200 | 106 |
| ..... | ..... | ..... | ..... | 1M | LJW | RE | 1M | SW | US | D | D | ..... | ..... | ..... | ..... | ... | IR | M,T | US,WO | ..... | ..... | ..... | Pn | BM | 168.5 | 107 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | ..... | ..... | ..... | D | ..... | ..... | ..... | ..... | ..... | 1 | FS | M | ..... | R | Z | ..... | Pn | ..... | 14 | 108 |
| Tr | ..... | BE | ..... | 1Du | PD | GE,WO | 1Du | PD | GE,WO | V | V | 6 | St | DP | Pn | 1 | IR | M | GE | ..... | ..... | ..... | Pn | HCC | 170 | 109 |
| ..... | ..... | ..... | ..... | M | ..... | ..... | N | ..... | ..... | D | ..... | 1 | St | ..... | ..... | 2[2] | ..... | M,T | ..... | S | ..... | ..... | ..... | ..... | 60 | 110 |
| ..... | ..... | ..... | ..... | 1Du | AS | GE,EL | ..... | ..... | ..... | V | ..... | 2 | St | DP | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 170 | 111 |
| ..... | ..... | ..... | ..... | 1M | ..... | LA | ..... | ..... | ..... | V | ..... | 2 | St | CV | ..... | 3[2] | IR | M | ..... | ..... | CLZ | ..... | E | ..... | 110 | 112 |
| ..... | ..... | ..... | ..... | 1T | CF | EL | ..... | ..... | ..... | D | ..... | 2 | St | DP | ..... | ... | ..... | ..... | ..... | ..... | Z | COC | Pn | HCC | 70 | 113 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | 1M | BF | AC | ..... | D | ..... | ..... | ..... | ..... | 1 | ..... | M | AC | R | ..... | ..... | E | CC | 50 | 114 |
| ..... | ..... | ..... | ..... | 1M | CF | ..... | N | ..... | ..... | D | ..... | ..... | ..... | ..... | ..... | 2 | GP | M,T | LA,TE | ..... | CLZ | PM | ..... | ..... | 100 | 115 |
| ..... | ..... | ..... | ..... | 1M | AL | WE | N | ..... | ..... | ..... | ..... | 1 | St | DP | ..... | 1 | AU | M | US | ..... | Z | ..... | Pn | CC | 90 | 116 |
| ..... | ..... | ..... | ..... | 1Du | FA | GE,EL | N | ..... | ..... | ..... | ..... | 3 | St | DP | ..... | 1 | IR | T | TE | R | ..... | ..... | Pn | BM | 371 | 117 |
| ..... | ..... | ..... | ..... | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1 | St | DP | ..... | 2[2] | IR | M,T | COP | R | ..... | ..... | Pn | ..... | 44 | 118 |
| ..... | ..... | ..... | ..... | 1M | CF | ..... | ..... | ..... | ..... | V | ..... | 3 | St | CV | ..... | 1 | IR | M | ..... | R | ..... | ..... | Pn | HCC | ..... | 119 |
| RR | Be | Be | ..... | 1M | AS | HEM | 1M | AS | HEM | D | D | 8 | Air | CV | Pn | 1 | DL | M | HEM | ..... | ..... | ..... | ..... | ..... | 360 | 120 |
| ..... | ..... | ..... | ..... | 1M | CF | GE | N | ..... | ..... | D | ..... | 1 | St | DP | ..... | 2[3] | ..... | M,Rp | WE | ..... | ..... | ..... | Pn | BM | 70.2 | 121 |
| ..... | ..... | ..... | ..... | N | ..... | ..... | 1M | BF | ..... | ..... | D | ..... | St | ..... | ..... | 2[9] | ..... | M,T | ..... | ..... | So | ..... | Pn | RF | 60 | 122 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | N | ..... | ..... | D | ..... | ..... | ..... | ..... | ..... | 1 | ..... | M | CEN | ..... | HLZ | ..... | Pn | ..... | 34 | 123 |
| ..... | ..... | ..... | ..... | 1M | CF | ..... | ..... | ..... | ..... | ..... | ..... | 1 | St | CV | ..... | 2 | CSL | M | ..... | ..... | CLZ | ..... | E | MH | 45 | 124 |
| RR | ..... | ..... | ..... | 1Du | SW | ..... | 1T | CS | ..... | V | D | 2 | St | CV | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | Pn | BM | 65 | 125 |
| ..... | ..... | ..... | ..... | 1T | LJW | LJW | ..... | ..... | ..... | S,V | ..... | 1 | St | DP | ..... | Ex | ..... | ..... | ..... | ..... | ..... | ..... | Pn | BM | 160 | 126 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | 1M | ..... | ..... | ..... | ..... | 5 | St | ..... | ..... | 3 | ..... | ..... | ..... | ..... | Z | ..... | E | HC | 150 | 127 |
| ..... | ..... | ..... | ..... | 1M | CF | LA | ..... | ..... | ..... | V | ..... | 1 | St | DP | ..... | 3[2] | GP,FM | 2M,IT | ..... | R | Z | ..... | Pn | HCC | 73 | 128 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | ..... | ..... | ..... | D | ..... | 1 | St | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 129 |
| ..... | ..... | ..... | ..... | 1M | AL | FM | ..... | ..... | ..... | V | ..... | ..... | ..... | ..... | ..... | 2 | AU | M,T | AC,COP | R | Z | ..... | E | CC | 27 | 130 |

BM - Bailey Meter Co
BT - Bridge & Tank, Winnipeg
BW - Babcock & Wilcox Co
BWG - Babcock-Wilcox & Goldie-McCulloch
CB - Cleaver Brooks Co
CBC - Chicago Blower Corp
CBL - Chicago Blower Ltd
CC - Coen Co
CCI - Cleveland Controls Inc
CE - Combustion Engineering, Inc
CEN - Century Electric Co
CF - Clarage Fan Co
COC - Cochrane Corp
COP - Coppus Engineering Corp
CP - Canada Pumps
CPC - Carver Pump Co
CS - Canadian Sirocco Co Ltd
CSL - Chas S Lewis & Co Ltd
CT - Carling Turbine Blower Co
CV - Copes-Vulcan Div, Blaw-Knox Co
CVL - Canadian Vickers Ltd
DBL - Darling Bros, Ltd
DBP - Dean Brothers Pumps Inc
DCC - Dearborn Chemical Co
DHP - Dean Hill Pump Co
DL - DeLaval Steam Turbine Co
DP - Diamond Power Specialty Corp
DSC - Detroit Stoker Co
EC - Erie City Iron Works
ECA - Electronics Corp of America
ED - Electro Dynamic Div of General Dynamics Corp
EL - Elliott Co
ES - Elgin Softener Corp
FA - Fly Ash Arrestor Corp
FE - Fairfield Engineering Co
FM - Fairbanks, Morse & Co
FS - Fred H Schaub Engrg Co
GB - General Blower Co
GC - General Controls Co
GE - General Electric Co
GF - Green Fuel Economizer Co, Inc
GP - Goulds Pumps Inc
HC - The Hays Corp
HCC - Hagan Chemicals & Controls Inc
HCE - Hoffman Combustion Engrg Co
HEM - Howell Electric Motors Co
HT - Hungerford & Terry Inc
IF - Iron Fireman Mfg Co
IR - Ingersoll-Rand Co
K - E Keeler Co
LA - The Louis Allis Co
LB - Link Belt Co
LJW - L J Wing Mfg Co
LS - Laclede Stoker Co
ME - Marathon Electric Mfg Co
MH - Minneapolis-Honeywell Regulator Co
MI - Murray Iron Works Co
NE - Nash Engrg Co
PD - Prat-Daniel Corp
PEC - Peabody Engrg Corp
PET - Petro
PM - Permutit Co, Div of Pfaudler Permutit, Inc
PPC - Pennsylvania Pump & Compressor Co
PPD - Peerless Pump Div, Food Machinery & Chemical Corp
RB - Ray Burner Sales Inc
RC - Research-Cottrell, Inc
RE - Reliance Electric & Engrg Co
RF - Republic Flow Meters Co
RG - Reliance Gage Column Co
RIM - Reliance Instrument Mfg Co
RS - Riley Stoker Corp
RV - Robinson Ventilating Co
SA - Stephens Adamson Mfg Co
SCI - Superior Combustion Industries, Inc
SL - Sheldons Ltd
SW - Sturtevant Div, Westinghouse Electric Corp
TE - Terry Steam Turbine Co
TS - Todd Shipyards Corp, Products Div
UC - United Conveyor Corp
UI - Union Iron Works
UP - Union Steam Pump Co
US - U S Electrical Motors Inc
VO - Henry Vogt Machine Co
WA - Woods Aerofoil
WE - Westinghouse Electric Corp
WI - Wickes Boiler Co
WMC - Whiton Machine Co
WO - Worthington Corp
WP - Western Precipitation Corp
WPM - Weinman Pump Mfg Co

# Table 3 1961 design survey: typical industrial,

| Project Number | Company & Location | Consulting Engineers | New or existing plant | Date of initial operation | Principal steam use | NEW BOILERS: Number new boilers | Manufacturer | Operating pressure, psig | Operating temperature, F | Boiler type | Capacity each, 1000 lb per hr | Boiler and waterwall surface, 1000 sq ft | Furnace volume 1000 cu ft | Furnace heat release, 1000 Btu per cu ft per hr | Furnace type | NEW FIRING EQUIPMENT: Firing method | Manufacturer | Fuel type | Heating value 1000 Btu per lb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **140 TO 121 PSIG (Cont)** | | | | | | | | | | | | | | | | | | | |
| 131 | Buckeye Garment Rental Co, Cleveland, Ohio | | Ex | ..... | Pr | 2 | K | 125 | Sat | WT | 22 | ..... | ..... | ..... | DB, Pd | Rog, RC | ..... | O, G | ..... |
| 132 | Carnation Co, Spokane, Wash | | Ex | 1961 | Pr | 1 | BW | 125 | Sat | WT | 14 | ..... | ..... | ..... | Pd | Br | ..... | G | ..... |
| 133 | Cedar Apartments, Cleveland, Ohio | Byers, Urban, Klug & Pittenger | Ex | 1960 | SH | 1 | CE | 125 | Sat | WT | 22 | 3.3 | 0.9 | 33.2 | BD | DGS | HCE | C | 12 |
| 134 | Children's Memorial Hospital, Chicago, Ill | Smith, Gardner & Ericson | Ex | ..... | Pr, SH | 1 | BW | 125 | Sat | WT | 24 | 2.7 | ..... | ..... | Pd | Rog | ..... | O, G | ..... |
| 135 | Crunden Martin Mfg Co, St Louis, Mo | | Ex | 1-60 | Po | 2 | K | 125 | Sat | WT | 20 | 2.3 | 0.5 | 51 | Pd | Br | ..... | O, G | ..... |
| 136 | Cummins Engine Co, Columbus, Ind | Samuel Lewis & Assoc | Ex | 1961 | SH | 1 | BW | 125 | Sat | WT | 36 | 4.0 | 1.1 | 41.8 | Pd | Ro | ..... | O | 18.4 |
| 137 | Ford Motor Co, Nashville, Tenn | | Ex | 9-60 | Pr, SH | 1 | BW | 125 | Sat | WT | 80 | 9.6 | 2.9 | ..... | BD | Br | ..... | O, G | ..... |
| 138 | Hamilton Beach Co, Racine, Wis | | Ex | 1960 | Pr, SH | 3 | CB | 125 | Sat | FT | 7 | ..... | ..... | ..... | Pd | Rog | ..... | O, G | ..... |
| 139 | Homart Development Corp, Ft Worth, Tex | Geo L Dahl | New | 1961 | SH | 2[5] | CB | 125 | 210 | FT | 16.7[4] | 2.5 | ..... | ..... | ..... | Rg | ..... | G | ..... |
| 140 | Indiana State College, Terre Haute, Ind | A & E Engineers | Ex | 1961 | SH | 1 | VO | 125 | Sat | WT | 60 | 7.7 | 2.7 | ..... | BD | CG | LS | C | 11.0 |
| 141 | Kawecki Chemical Co, Boyertown, Pa | | Ex | 1960 | Pr, SH | 1 | SCI | 125 | Sat | FT | 20 | ..... | ..... | ..... | ..... | RC | ..... | O | ..... |
| 142 | Keyes Fibre Co, Waterville, Me | | Ex | ..... | Pr, SH | 1 | BW | 125 | Sat | WT | 39 | 4.3 | ..... | ..... | BD | Br | ..... | O | ..... |
| 143 | Liggett & Myers Tobacco Co, St Louis, Mo | | Ex | 1-60 | Pr | 2 | K | 125 | Sat | WT | 30 | 4.0 | 1.0 | 40 | BD | Br | ..... | ..... | ..... |
| 144 | Bob Jones University, Greenville, S C | J C Harrison | Ex | 9-60 | SH | 1 | CE | 125 | Sat | WT | 40 | 3.5 | 1.0 | ..... | Pd | Br | ..... | O, G | ..... |
| 145 | Kieffer Paper Mills, Brownstown, Ind | H M Wilson Co, Inc | Ex | 1961 | Pr | 1 | BW | 125 | Sat | WT | 52 | 5.9 | 2.4 | 27 | BD | CG | BW | C | 11.7 |
| 146 | Koppers Co, Inc, Gainesville, Fla | | Ex | 10-60 | Pr | 1 | BW | 125 | Sat | WT | 20 | 3 | ..... | ..... | BD | DGS | DSC | WW, C | ..... |
| 147 | McCormick Mill, McCormick, S C | Lockwood Greene Engineers Inc | Ex | 1961 | Pr | 1 | BW | 125 | Sat | ..... | 30 | 3.6 | 0.9 | ..... | Pd | Rog | ..... | O | ..... |
| 148 | Norwich Pharmacal, Norwich, N Y | | Ex | 1960 | Pr, SH | 2 | CB | 125 | Sat | FT | 34 | ..... | ..... | ..... | ..... | Rog | ..... | O, G | ..... |
| 149 | Pavillion St Georges, Sherbrooke, P Q | Cote, LeClair & Langlois | New | 1962 | Pr, SH | 2 | CVL | 125 | Sat | ..... | 27 | 4.0 | 1.3 | 26.2 | BD | Rog | ..... | O | 18.5 |
| 150 | Rath Packing Co, Columbus Junction, Iowa | | New | 1961 | Pr | 1 | CB | 125 | Sat | FT | ..... | ..... | ..... | ..... | ..... | Br | ..... | O, G | ..... |
| 151 | Joseph T Ryerson & Son, Inc, Chicago, Ill | Samuel R Lewis & Assoc | Ex | ..... | SH | 1[5] | CE | 125 | 240 | WT | 34[4] | 4 | 1 | 49 | BD | Br | ..... | O | ..... |
| 152 | St Joseph Hospital, Lorain, Ohio | Byers, Urban, Klug & Pittenger | ..... | ..... | SH | 2 | BW | 125 | Sat | WT | 14 | 1.5 | 0.4 | 40 | Pd | Br | ..... | O, G | 18.0 |
| 153 | St Lukes Hospital, Milwaukee, Wis | Schmidt, Garden & Erickson | Ex | 1961 | Pr, SH | 1 | BW | 125 | Sat | WT | 22 | ..... | ..... | ..... | ..... | Rog | ..... | O, G | ..... |
| 154 | Joseph E Seagram & Sons Ltd, Waterloo, Ont | Walter, Fedy & Assoc | New | 1961 | Pr | 1 | BWG | 125 | Sat | WT | 60 | 5.8 | 1.5 | 54.8 | Pd | Rog | ..... | G, O | 1000[1] |
| 155 | Joseph E Seagram & Sons Ltd, Waterloo, Ont | Walter, Fedy & Assoc | New | 1961 | Pr | 1 | BWG | 125 | Sat | WT | 35 | 4.3 | 1.1 | 54.8 | Pd | Rog | ..... | G, O | 1000[1] |
| 156 | G D Searle & Co, Skokie, Ill | Jos P Bazzoni Assoc | Ex | 1961 | Pr, SH | 1 | BW | 125 | Sat | FT | 32 | 3.8 | ..... | ..... | ..... | Br | ..... | O, G | ..... |
| 157 | Sisters of Providence, St Mary of the Woods, Inc | | Ex | 1961 | SH | 1 | VO | 125 | Sat | WT | 20 | 3.8 | ..... | ..... | BD | SR | CE | C | 11.9 |
| 158 | Tacoma General Hospital, Tacoma, Wash | David M Hopkins & Assoc | New | 1961 | SH | 2 | BW | 125 | Sat | WT | 20 | 2.0 | 0.5 | 45 | Pd | Br | ..... | G | ..... |
| 159 | United Aircraft Corp, Norden Div, Norwalk, Conn | Wigton-Abbott | ..... | 1960 | SH, Pr | 3 | SCI | 125 | Sat | WT | 17.5 | 2.3 | ..... | ..... | Pd | Rog | ..... | O | 18.5 |
| 160 | Western State College, Gunnison, Colo | Stone & Birkle | Ex | 1960 | SH | 1 | CE | 125 | Sat | WT | 55 | 7.5 | 2.1 | 35 | BD | CG | CE | C | ..... |
| 161 | Wyckoff Steel Co, Ambridge, Pa | | New | 1960 | Pr, SH | 2 | VO | 125 | Sat | WT | 30 | ..... | ..... | 35 | ..... | Rog | ..... | G, O | 1000[1] |
| **120 TO 101 PSIG** | | | | | | | | | | | | | | | | | | | |
| 162 | Johnson & Johnson, Bedford Park, Ill | | Ex | 1960 | Pr, SH | 1 | BW | 120 | Sat | WT | 50 | 4.0 | ..... | ..... | Pd | Rog | ..... | O, G | ..... |
| 163 | Kimberly-Clark Co, Schweitzer Div, Mt Holly Springs, Pa | | Ex | 1960 | Pr, SH | 1 | K | 120 | Sat | WT | 45 | 5.0 | 1.1 | 49 | Pd | Br | ..... | O | ..... |
| 164 | Wm Neilson Ltd, Toronto, Ont | | Ex | 1961 | Pr, SH | 2 | BW | 120 | Sat | WT | 25 | 3.1 | ..... | ..... | Pd | Rog | ..... | O | ..... |
| 165 | Colorado State Univ, Ft Collins, Colo | Riley Engineering Corp | Ex | 60-61 | SH | 1 | UI | 115 | Sat | WT | 67 | ..... | ..... | ..... | BD | Rog | ..... | G, O | 830[1] |
| 166 | Geisinger Memorial Hospital, Danville, Pa | Ellerby Co | Ex | 1961 | Pr, SH | 1 | K | 110 | Sat | WT | 8.6 | ..... | ..... | ..... | ..... | Sto | ..... | An | 13 |
| 167 | Univ of Arkansas Medical Center, Little Rock, Ark | Farhart, Eichenbaum, Rauch & Blass | Ex | ..... | ..... | 1 | BW | 110 | Sat | WT | 52 | ..... | ..... | ..... | BD | Br | ..... | G | ..... |
| 168 | Wisconsin School for Boys, Wales, Wis | State Bureau of Engineering | Ex | ..... | SH | 1 | K | 110 | Sat | WT | 12 | 2 | ..... | 30 | BD | SR | RS | C | ..... |
| 169 | Morganton Hosiery Mill Inc, Morganton, N C | Bibberstein-Bowis | New | 1961 | Pr | 1 | K | 105 | Sat | WT | 21 | ..... | ..... | ..... | BD | Rog | ..... | O, G | ..... |
| 170 | Traylor Div, Fuller Co, Allentown, Pa | Lehigh Engineering Co | Ex | 10-60 | SH | 2 | SCI | 105 | Sat | FT | 13.8 | ..... | ..... | ..... | Pd | RC | ..... | O | ..... |
| **100 PSIG AND BELOW** | | | | | | | | | | | | | | | | | | | |
| 171 | Allentown General Hospital, Allentown, Pa | Gilbert Assoc | Ex | 1961 | Pr | 2 | K | 100 | Sat | WT | 20 | 3.0 | ..... | ..... | ..... | Rog | ..... | O | 18.5 |
| 172 | Allentown General Hospital, Allentown, Pa | Gilbert Assoc | Ex | 1961 | Pr | 1 | K | 100 | Sat | WT | 10 | 1.5 | ..... | ..... | ..... | Rog | ..... | O | 18.5 |
| 173 | Baxter Laboratories Inc, Kingstree, S C | Austin Co | New | 1961 | Pr | 1 | BW | 100 | Sat | WT | 20 | 3.0 | 0.8 | 27 | BD | At | ..... | O | ..... |
| 174 | Borg-Warner, Norge Div, Fort Smith, Ark | | New | ..... | Pr, SH | 3 | WI | 100 | Sat | WT | 30 | 3.6 | 0.8 | 40 | ..... | Rg | ..... | G | ..... |
| 175 | Brookline Fabrics, Inc, Greenville, S C | | New | 1961 | Pr | 1 | SCI | 100 | Sat | FT | 21 | ..... | ..... | ..... | ..... | RC | ..... | G, O | 1000[1] |
| 176 | Darst Apartments, St Louis, Mo | John D Falvey | Ex | 1-60 | SH | 1 | K | 100 | Sat | WT | 26 | 3.1 | 0.7 | 48 | Pd | Br | ..... | O, G | ..... |
| 177 | General Electric Co, Chicago Heights, Ill | | Ex | 8-60 | Pr, SH | 2 | BW | 100 | Sat | WT | 15 | 1.8 | 0.5 | ..... | Pd | Br | ..... | O, G | 18.0 |
| 178 | General Electric Co, Plainville, Conn | Lockwood Greene Engineers Inc | Ex | 1961 | Pr, SH | 2 | CB | 100 | ..... | FT | 10.5 | ..... | ..... | ..... | ..... | Rog | ..... | O, G | ..... |
| 179 | Mack Trucks, Inc, Hagerstown, Md | Giffels & Rossetti | New | 1961 | SH | 3 | WI | 100 | Sat | WT | 100 | 9.6 | 3 | 39 | Pd | Rog | ..... | G, O | 1000[1] |
| 180 | New Yarmouth Hospital, Yarmouth, N S | McDougall & Friedman | New | 1961 | Pr, SH | 2 | CB | 100 | Sat | FT | 8.6 | 1.2 | ..... | ..... | ..... | Rog | ..... | O | ..... |
| 181 | Sacred Heart Seminary, Detroit, Mich | Hyde & Bobbio, Inc | Ex | 1961 | Pr, SH | 1 | K | 100 | Sat | WT | 15 | 2.1 | ..... | ..... | BD | Rog | ..... | O, G | ..... |
| 182 | St Joseph's Hospital, Milwaukee, Wis | Wm Tao | Ex | 1961 | Pr, SH | 3 | K | 100 | Sat | WT | 21 | 2.4 | 0.5 | ..... | ..... | Rog, RC | ..... | O, G | ..... |
| 183 | Sperry Gyroscope Co, Great Neck, N Y | | Ex | 1961 | Pr, SH | 1 | CE | 100 | Sat | WT | 30 | 3.6 | ..... | ..... | Pd | Rog | ..... | O, G | ..... |
| 184 | Theda Clark Memorial Hospital, Neenah, Wis | | Ex | 1962 | SH | 1 | BW | 100 | 535 | WT | 10 | 2.2 | 0.6 | ..... | BD | Rog | ..... | G, O | 1000[1] |
| 185 | Western Electric Co, Inc, Winston-Salem, N C | | Ex | 1961 | Pr, SH | 1 | BW | 100 | Sat | WT | 30 | 3.8 | 0.9 | 43.2 | Pd | Rog | ..... | O, G | ..... |
| 186 | Roach Appleton Mfg Co, South Bend, Ind | Sumner Sollitt | Ex | ..... | Pr, SH | 1[5] | CB | 90 | 300 | FT | 10[4] | ..... | ..... | ..... | ..... | Br | ..... | O | ..... |
| 187 | Torrington Co, Clinton, S C | | New | 1961 | ..... | 2 | CB | 90 | 400 | FT | ..... | ..... | ..... | ..... | ..... | ..... | ..... | O, G | ..... |
| 188 | Children's Hospital, Baltimore, Md | L E Mitchell Co | New | 1960 | Pr | 2 | K | 85 | Sat | WT | 18 | ..... | ..... | ..... | Pd | Br | ..... | O | ..... |
| 189 | University of Michigan, Ann Arbor, Mich | Cummins & Barnard Inc | New | 1960 | SH | 2 | EC | 75 | Sat | FT | 10 | 1.6 | ..... | ..... | Pd | Rog | ..... | G, O | 1000[1] |

**SYMBOLS USED ABOVE**

An - Anthracite
At - Steam assisted mechanical atomizing
Ba - Bagasse
BD - Balanced draft
BE - Bucket Elevator
Be - Belt
BKE - Bar and toy stoker
Br - Burner
C - Coal, bituminous
CDS - Continuous discharge spreader stoker
CG - Chain grate stoker
CLZ - Cold lime zeolite
Cy - Cyclone
D - Damper
DB - Dry bottom
De - Demineralizer
DGS - Dump grate spreader stoker
Du - Dual Drive
E - Electrical
Ex - Existing plant or equipment
Fl - Flight
FT - Fire tube
G - Gas
HLS - Hot lime soda
HLZ - Hot lime zeolite
Hyd - Hydraulic
M - Motor
Ma - Magnetic coupling
Me - Mechanical
Mi - Mixed bed demineralizer
Mu - Multibed demineralizer
N - None
O - Oil
PC - Pulverized coal
Pd - Pressurized
Pn - Pneumatic
Po - Power
Pr - Process
R - Regulator
RC - Rotary cup burner
Rg - Register gas burner
Ro - Register oil burner
Rog - Register oil-gas burner
Rp - Reciprocating steam
RR - Railroad
S - Speed
Sat - Saturated
SC - Stacking conveyor
SH - Space heat
So - Softening
SR - Single retort underfeed stoker
St - Steam
Sto - Stoker
Sw - Screw Conveyor
T - Turbine
Tr - Truck
V - Vane
VG - Vibrating grate
WT - Water tube
WW - Wood Waste
Z - Zeolite softening
1 - Btu per cu ft
2 - For 2 boilers
3 - For all boilers
4 - Million Btu per hr
5 - High temperature water
6 - High temperature water circulating pumps
7 - On bagasse; 60,000 lb per hr on gas
8 - For 4 boilers
9 - For 3 boilers
10 - 2 turbines, 500 kw each

**MANUFACTURERS**

AC - Allis-Chalmers Mfg Co
AE - American Engineering Co
AL - Aladdin Heating Corp
AM - American Marsh Pumps, Inc.
APr - Air Preheater Corp
AS - American Standard, Ind Div
ASH - Allen-Sherman-Hoff Co
ASL - AS Leitch
AU - Aurora Pump Div
AWC - A W Cash Co
BA - The Bayer Co
BAC - Bird-Archer Co
BC - Bepco Canada Ltd
BE - Betz Laboratories, Inc
BEC - Baldor Electric Co
BF - Buffalo Forge Co
BJ - Byron Jackson Pumps, Inc

# institutional plants, 200 psig and below

| COAL HANDLING EQUIPMENT | | | | F. D. FANS | | | I. D. FANS | | | AIR & GAS FLOW CONTROL | | SOOT BLOWERS | | | Ash handling system | FEED WATER PUMPS | | | | | WATER TREATMENT | | Combustion control | Control manufacturer | Total plant boiler capacity 1000 lbs per hr | Project Number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Delivery method to plant site | Stockpile to in-plant storage | In-plant handling equipment | Manufacturer | No. and drive | Fan manufacturer | Drive manufacturer | No. and drive | Fan manufacturer | Drive manufacturer | Air flow | Gas flow | No. per boiler | Type | Manufacturer | | Number per boiler | Pump manufacturer | Drive type | Drive manufacturer | Pump control | Type | Manufacturer | | | | |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1 | St | ..... | ..... | ... | ..... | Du | AU | ..... | Z | ..... | ... | ..... | 33 | 131 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | St | ..... | ..... | 1 | ..... | M | ..... | R | Z | ..... | E | CC | 20 | 132 |
| Tr | FI | Sw,FI | FE | 1M | CF | ..... | 1M | SW | ..... | ..... | ..... | ..... | ..... | ..... | Pn | 1 | ..... | ..... | ..... | ..... | Z | ..... | Pn | HCC | 35 | 133 |
| ..... | ..... | ..... | ..... | 1 | ..... | ..... | 1M | ..... | ..... | V | V | 1 | St | DP | ..... | 1 | NE | T | ..... | R | Z | ..... | E | TS | 34 | 134 |
| ..... | ..... | ..... | ..... | 1M | CF | ..... | ..... | ..... | ..... | V | ..... | 1 | St | CV | ..... | Ex | ..... | ..... | ..... | ..... | CLZ | COC | E | PEC | 40 | 135 |
| ..... | ..... | ..... | ..... | 1M | CF | ..... | ..... | ..... | ..... | D | ..... | 2 | St | DP | ..... | 3 | WO | M | ..... | R | Z | ..... | Pn | BM | 93 | 136 |
| ..... | ..... | ..... | ..... | 1M | BF | ..... | 1M | BF | ..... | D | D | ..... | St | CV | ..... | 1 | BF | M | GE | ..... | So | PM | Pn | BM | 320 | 137 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 2 | CPC | M | ..... | ..... | ..... | ..... | ... | ..... | 21 | 138 |
| ..... | ..... | ..... | ..... | 1M | CB | ..... | ..... | ..... | ..... | D | ..... | ..... | ..... | ..... | ..... | 26 | PPD | ..... | ..... | ..... | Z | ..... | ... | ..... | 33,54 | 139 |
| Tr | FI | BE | ..... | 1M | FA | ..... | 1M | FA | ..... | D | D | ..... | St | CV | Pn | ... | ..... | ..... | ..... | ..... | ..... | ..... | Pn | RF | 150 | 140 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1M | SCI | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1 | AU | M | GE | R | ..... | ..... | E | MH | ..... | 141 |
| ..... | ..... | ..... | ..... | 1M | BF | ..... | ..... | ..... | ..... | D | ..... | 2 | St | DP | ..... | 1 | WPI | M | ..... | ..... | ..... | ..... | Pn | BM | 120 | 142 |
| ..... | ..... | ..... | ..... | 1M | CF | ..... | ..... | ..... | ..... | ..... | ..... | 1 | St | CV | ..... | 1 | IR | M | ..... | R | CLZ | ES | E | HC | ..... | 143 |
| ..... | ..... | ..... | ..... | 1M | AL | ..... | ..... | ..... | ..... | ..... | ..... | ..... | St | DP | ..... | 1 | PPC | ..... | ..... | ..... | ..... | ..... | E | CC | 72 | 144 |
| RR,Tr | ..... | BE | ..... | 1M | SW | WE | 1M | PD | GE | V | D | 2 | St | DP | Pn | 2 | DBP | ..... | ..... | ..... | ..... | ..... | Pn | BM | 52 | 145 |
| RR | ..... | ..... | ..... | 1M | RV | ..... | 1M | RV | ..... | D,V | D | 1 | St | DP | ..... | 2 | UP | Rp | ..... | S | Z | PM | Pn | BM | ..... | 146 |
| ..... | ..... | ..... | ..... | 1M | CC | FM | ..... | ..... | ..... | D | ..... | 1 | St | ..... | ..... | 2 | GP | M | ..... | R | Z | ..... | E | ECA | 45 | 147 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | 148 |
| ..... | ..... | ..... | ..... | 1M | CBL | ..... | ..... | ..... | ..... | V | ..... | 1 | St | DP | ..... | 1 | ..... | Rp | ..... | S | CLZ | ..... | Pn | ..... | 54 | 149 |
| ..... | ..... | ..... | ..... | M | ..... | ..... | ..... | ..... | ..... | ..... | ..... | N | ..... | ..... | ..... | 2 | ..... | M | ..... | ..... | Z | ..... | E | CB | 15 | 150 |
| ..... | ..... | ..... | ..... | 1M | CE | ..... | ..... | ..... | ..... | ..... | ..... | 1 | Air | DP | ..... | 2 | AM | M | ..... | R | ..... | ..... | Pn | ..... | ..... | 151 |
| ..... | ..... | ..... | ..... | 1M | GF | FM | N | ..... | ..... | V | ..... | ..... | ..... | ..... | ..... | 1 | WO | ..... | ..... | ..... | Z | ..... | E | TS | 28 | 152 |
| ..... | ..... | ..... | ..... | 1M | CF | ..... | ..... | ..... | ..... | ..... | ..... | 1 | ..... | DP | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | 153 |
| ..... | ..... | ..... | ..... | 1M | SL | BC | ..... | ..... | ..... | D | ..... | 2 | St | DP | ..... | 2[2] | CP | M | ..... | R | Z | COC | Pn | BM | 95 | 154 |
| ..... | ..... | ..... | ..... | 1M | SL | BC | ..... | ..... | ..... | D | ..... | 2 | St | DP | ..... | 2[2] | CP | M | ..... | R | Z | COC | Pn | BM | 95 | 155 |
| ..... | ..... | ..... | ..... | 1M | PD | US | 1M | PD | ..... | ..... | ..... | 1 | St | DP | ..... | 1 | IR | M | ..... | ..... | ..... | BE | ..... | ..... | 76 | 156 |
| ..... | ..... | ..... | ..... | 1M | CF | EL | ..... | ..... | ..... | V | ..... | 3 | St | DP | ..... | 1 | PPD | M | WE | R | CLZ | ..... | Hyd | AWC | 75 | 157 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | ..... | ..... | ..... | D | ..... | 1 | ..... | ..... | ..... | 2[2] | WO | M,T | ..... | R | ..... | ..... | Pn | BM | 40 | 158 |
| ..... | ..... | ..... | ..... | 1M | CF | GE | ..... | ..... | ..... | D | ..... | 2 | St | BA | ..... | 1 | ..... | M | US | R | ..... | ..... | Pn | RG | 51 | 159 |
| Tr | BE | Sw,BE | FE | 1M | AS | ..... | 1T | AS | TE | D | S | 4 | ..... | CV | Pn | 2 | FM | M,T | TE | R | CLZ | HCC | E | HC | 80 | 160 |
| ..... | ..... | ..... | ..... | 1 | FM | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 2 | AC,GP | M | ..... | R | So,De | DCC | Pn | ECA | 60 | 161 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1M | CF | ..... | ..... | V | 2 | St | ..... | ..... | 2 | DBP,IR | M,T | TE | R | So,De | DCC | Pn,E | ..... | 115 | 162 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | N | ..... | ..... | D | ..... | 1 | St | CV | ..... | 2 | WPM | M | ..... | ..... | ..... | ..... | E | RIM | 90 | 163 |
| ..... | ..... | ..... | ..... | 1M | CF | GE | N | ..... | ..... | ..... | ..... | 1 | St | ..... | ..... | 1 | ..... | M | ..... | ..... | ..... | ..... | Pn | BM | 50 | 164 |
| ..... | ..... | ..... | ..... | 1M | AS | ..... | 1M | AS | ..... | D | D | 3 | St | DP | ..... | 2 | WO | T | TE | R | ..... | ..... | Pn | BM | ..... | 165 |
| Tr | FI | ..... | ..... | 1M | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1 | St | DP | Pn | ... | ..... | ..... | ..... | ..... | CLZ | ..... | E | CCI | 25.9 | 166 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | 167 |
| Tr | ..... | ..... | ..... | 1M | CBC | AC | ..... | ..... | ..... | D | ..... | 1 | St | DP | ..... | 1 | ..... | T | DHP | ..... | ..... | ..... | Pn | HC | 27.5 | 168 |
| ..... | ..... | ..... | ..... | 1M | IF | ..... | ..... | ..... | ..... | D | ..... | 1 | St | DP | ..... | 2 | WO | M | WO | ..... | COC | ..... | ... | ..... | 21 | 169 |
| ..... | ..... | ..... | ..... | 1M | SCI | ..... | ..... | ..... | ..... | D | ..... | ..... | ..... | ..... | ..... | 1 | FM | M | ..... | R | So | ..... | E | SCI | 28 | 170 |
| ..... | ..... | ..... | ..... | 2M | CF | ..... | ..... | ..... | ..... | V | ..... | 1 | St | DP | ..... | 1 | IR | T | COP | S | CLZ | ..... | E | ..... | 50 | 171 |
| ..... | ..... | ..... | ..... | 2M | CF | ..... | ..... | ..... | ..... | V | ..... | 1 | St | DP | ..... | 1 | IR | III | ..... | S | CLZ | ..... | E | ..... | 50 | 172 |
| ..... | ..... | ..... | ..... | 1M | GB | GE | 1M | CF | GE | D | D | 4 | St | DP | ..... | 2 | ..... | M,T | GE,COP | R | ..... | ..... | Pn | BM | 20 | 173 |
| ..... | ..... | ..... | ..... | 1M | BF | ..... | ..... | ..... | ..... | D | ..... | ..... | ..... | ..... | ..... | 1 | WO | M | ..... | R | HLZ | ..... | Pn | HC | 120 | 174 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1M | ..... | WE | ..... | ..... | ..... | ..... | ..... | ..... | 1 | AU | MI | ..... | ..... | ..... | ..... | Pn | GC | 38 | 175 |
| ..... | ..... | ..... | ..... | 1M | AS | BEC | ..... | ..... | ..... | V | ..... | 1 | St | CV | ..... | 2 | AU | M | CEN | ..... | ..... | ..... | E | PET | 26 | 176 |
| ..... | ..... | ..... | ..... | 1M | LJW | GE | N | ..... | ..... | V | ..... | 1 | St | DP | ..... | 1 | PPD | M | GE | ..... | HLS | COC | ... | ..... | 30 | 177 |
| ..... | ..... | ..... | ..... | 1M | CB | GE | ..... | ..... | ..... | D | ..... | ..... | ..... | ..... | ..... | 1 | FS | T | GE | ..... | De | BAC | E | MH | 46 | 178 |
| ..... | ..... | ..... | ..... | 1M | FA | ME | 1M | FA | ME | D | D | 3 | St | CV | ..... | 1 | BF | M,T | COP | S | Z | ..... | Pn | HC | 300 | 179 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 2 | DBL | M | ..... | R | ..... | DCC | ... | ..... | 17.2 | 180 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | ..... | ..... | ..... | D | ..... | 1 | St | ..... | ..... | 2 | BF | M | ..... | R | CLZ | ..... | E | HC | 40 | 181 |
| ..... | ..... | ..... | ..... | M | RB | LA | ..... | ..... | ..... | ..... | ..... | 1 | St | ..... | ..... | 2 | ..... | M,T | ..... | ..... | CLZ | ..... | ... | ..... | 63 | 182 |
| ..... | ..... | ..... | ..... | 1M | ..... | FM | ..... | ..... | ..... | D | ..... | 1 | St | CV | ..... | 1 | WO | M | GE | R | ..... | ..... | Pn | BM | 170 | 183 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | ..... | ..... | ..... | D | ..... | 1 | St | ..... | ..... | 1 | ..... | MI | ..... | ..... | ..... | ..... | ... | ..... | 40 | 184 |
| ..... | ..... | ..... | ..... | 1M | CF | ..... | ..... | ..... | ..... | V | ..... | ..... | ..... | ..... | ..... | 1 | WO | Rp | ..... | R | De | ..... | E | TS | 75 | 185 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | ..... | ..... | ..... | D | ..... | ..... | ..... | ..... | ..... | 56 | BF | ..... | ..... | ..... | ..... | ..... | E | ECA | 20[4] | 186 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | ..... | ..... | ..... | D | ..... | ..... | ..... | ..... | ..... | 1 | AU | M | ..... | ..... | ..... | ..... | E | ECA | ..... | 187 |
| ..... | ..... | ..... | ..... | 1M | ..... | ..... | N | ..... | ..... | D | ..... | 1 | ..... | ..... | ..... | 2 | GP | M | ..... | ..... | ..... | ..... | Pn | MH | 36 | 188 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | N | ..... | ..... | ..... | 1 | FS | M | ..... | ..... | ..... | ..... | E | MH | 20 | 189 |

BM - Bailey Meter Co
BT - Bridge & Tank, Winnipeg
BW - Babcock & Wilcox Co
BWG - Babcock-Wilcox & Goldie-McCulloch
CB - Cleaver Brooks Co
CBC - Chicago Blower Corp
CBL - Chicago Blower Ltd
CC - Coen Co
CCI - Cleveland Controls Inc
CE - Combustion Engineering, Inc
CEN - Century Electric Co
CF - Clarage Fan Co
COC - Cochrane Corp
COP - Coppus Engineering Corp
CP - Canada Pumps
CPC - Carver Pump Co
CS - Canadian Sirocco Co Ltd
CSL - Chas S Lewis & Co Ltd
CT - Carling Turbine Blower Co
CV - Copes-Vulcan Div, Blaw-Knox Co
CVL - Canadian Vickers Ltd
DBL - Darling Bros, Ltd
DBP - Dean Brothers Pumps Inc
DCC - Dearborn Chemical Co
DHP - Dean Hill Pump Co
DL - DeLaval Steam Turbine Co
DP - Diamond Power Specialty Corp
DSC - Detroit Stoker Co
EC - Erie City Iron Works
ECA - Electronics Corp of America
ED - Electro Dynamic Div of General Dynamics Corp
EL - Elliott Co
ES - Elgin Softener Corp
FA - Fly Ash Arrestor Corp
FE - Fairfield Engineering Co
FM - Fairbanks, Morse & Co
FS - Fred H Schaub Engrg Co
GB - General Blower Co
GC - General Controls Co
GE - General Electric Co
GF - Green Fuel Economizer Co, Inc
GP - Goulds Pumps Inc
HC - The Hays Corp
HCC - Hagan Chemical & Controls Inc
HCE - Hoffman Combustion Engrg Co
HEM - Howell Electric Motors Co
HT - Hungerford & Terry Inc
IF - Iron Fireman Mfg Co
IR - Ingersoll-Rand Co
K - E Keeler Co
LA - The Louis Allis Co
LB - Link Belt Co
LJW - L J Wing Mfg Co
LS - Laclede Stoker Co
ME - Marathone Electric Mfg Co
MH - Minneapolis-Honeywell Regulator Co
MI - Murray Iron Works Co
NE - Nash Engrg Co
PD - Pratt-Daniel Corp
PEC - Peabody Engrg Corp
PET - Petro
PM - Permutit Co, Div of Pfaudler Permutit, Inc
PPC - Pennsylvania Pump & Compressor Co
PPD - Peerless Pump Div, Food Machinery & Chemical Corp
RB - Ray Burner Sales Inc
RC - Research-Cottrell, Inc
RE - Reliance Electric & Engrg Co
RF - Republic Flow Meters Co
RG - Reliance Gage Column Co
RIM - Reliance Instrument Mfg Co
RS - Riley Stoker Corp
RV - Robinson Ventilating Co
SA - Stephens Adamson Mfg Co
SCI - Superior Combustion Industries, Inc
SL - Sheldons Ltd
SW - Sturtevant Div, Westinghouse Electric Corp
TE - Terry Steam Turbine Co
TS - Todd Shipyards Corp, Products Div
UC - United Conveyor Corp
UI - Union Iron Works
UP - Union Steam Pump Co
US - U S Electrical Motors Inc
VO - Henry Vogt Machine Co
WA - Wheels Aerofoil
WE - Westinghouse Electric Corp
WI - Wickes Boiler Co
WMC - Whiton Machine Co
WO - Worthington Corp
WP - Western Precipitation Corp
WPM - Weinman Pump Mfg Co

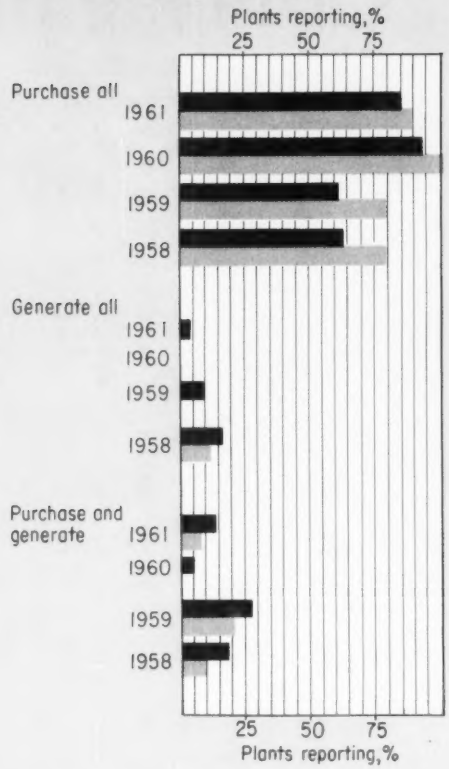
# 1961 electric-systems design survey:

## DISTRIBUTION TRENDS

- Less than 15% of plants generate
- Over 50% of main subs are self-owned
- ⅔ of main subs ground neutral
- Move to higher voltages continues

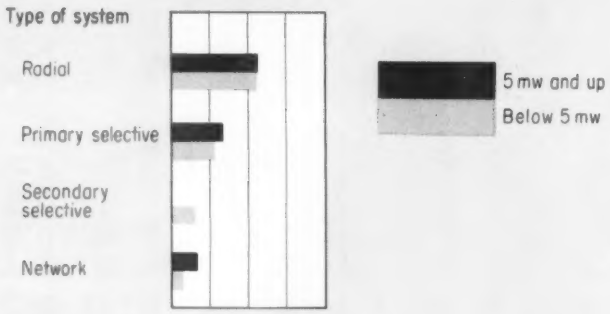
Design features of electric-distribution systems in the 60 plants surveyed are summarized on these pages. Tabulation of pertinent data begins on the following pages. Although our sampling is relatively small, it may be considered typical of current practice. For two items, power supply and main-sub ownership, we've compared this year's results with surveys of the past three years on the basis of percentage of plants reporting this data.

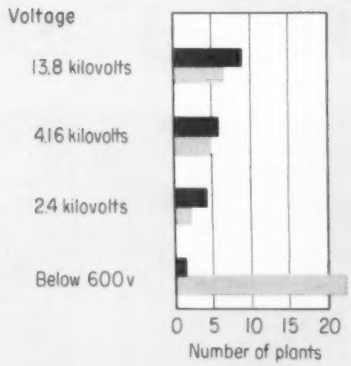
### POWER SUPPLY




**SELF-GENERATION, compared for last four years, increases slightly in '61. But this probably is not a trend away from purchased power**

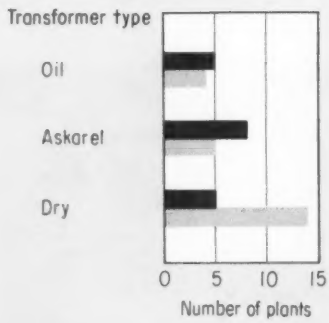
### PRIMARY DISTRIBUTION

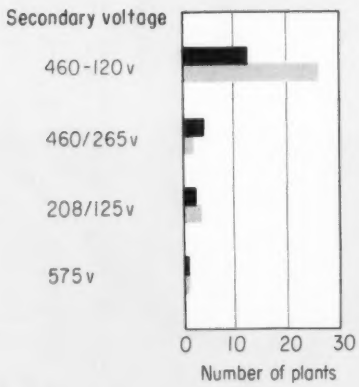



**VOLTAGES above 13.8 kv were reported for 3 plants; 13.8 group includes 11 and 12.5 kv**

### SECONDARY SUBSTATION



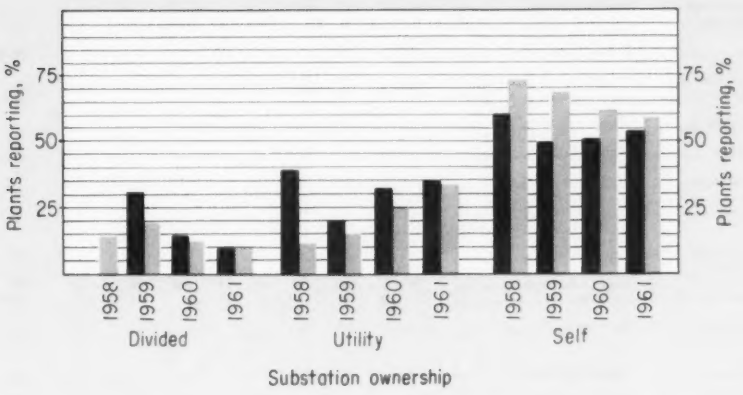

**DRY TRANSFORMERS have a clear lead in smaller plants. Favored voltages are 460 v for power applications and 120 v for lighting, with some 460Y/265 systems represented**

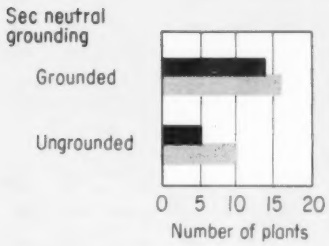


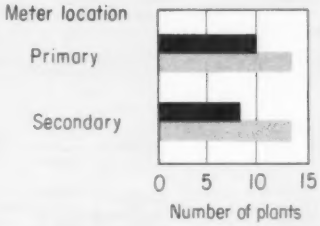
Design features of 60 typical electric

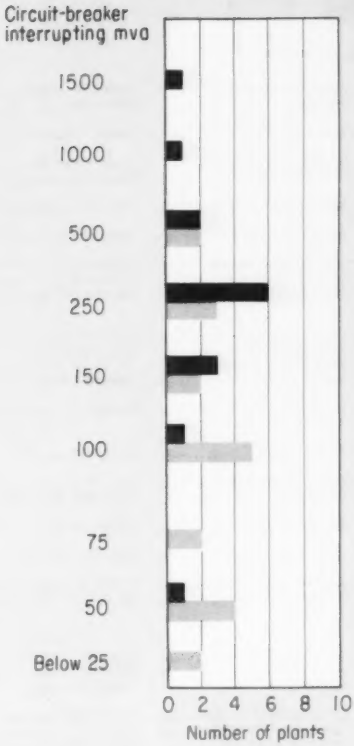
# typical industrial plants, institutions

## PRIMARY SUBSTATION



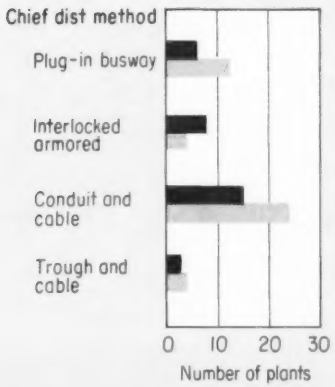



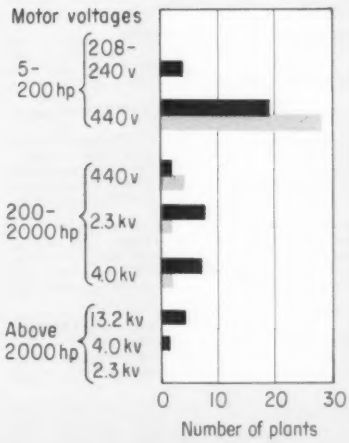

**MAIN-SUBSTATION** ownership, fluctuating slightly over last four years, is more than 50% in self-ownership column. Note slight but steady decline in divided ownership. Metering splits almost evenly between primary and secondary. Circuit breakers range widely

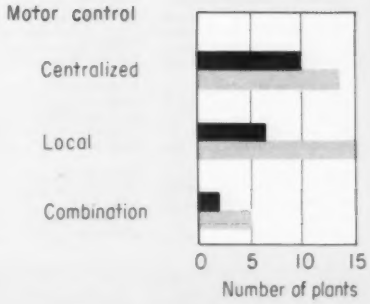
## SECONDARY DISTRIBUTION




**CABLE AND CONDUIT** holds its own although some other methods are adopted widely

## UTILIZATION




**MOTOR VOLTAGES** are dominated by 440 v through the 200-hp range, while 2.3 and 4 kv run about even from 200 to 2000 hp. Centralized control leads in larger plants



distribution systems

# Design features of 60 typical electric-

Each listing covers 3 pages. Project number helps you track a specific installation after you turn facing page

| Project Number | Company | Location | Electric Utility | Consulting Engineers | Date of initial operation | Plant area, acres | Total plant capacity, mw | EXISTING PLANT | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | TOTAL OLD LOAD | | Self generated, mw | Utility supplied, mw | VOLTAGES | | |
| | | | | | | | | Max mw | Avg pf | | | Utility supply, kv | Distribution, kv | Utilization, v |
| PLANTS 5 MW OR MORE | | | | | | | | | | | | | | |
| 1 | Argonne National Laboratory[1] | Argonne, Ill | Commonwealth Edison Co | Sverdrup & Parcel | 9-62 | 65 | 50 | No | | | | | | |
| 2 | Shell Oil Co | Houston, Tex | Houston Lighting & Power Co | | 9-60 | 1200 | 46 | 42 | .87 | 30 | 12 | 69 | 12,2.4 | 2.4,460 |
| 3 | Bowaters Carolina Corp | Catawba, SC | Duke Power Co | Bowaters Engrg & Devel Co | 6-62 | | 44 | 17 | .92 | 12.5 | 4.5 | 110/13.8 | .460 | 460,2300 |
| 4 | Monsanto Chemical Co | Chocolate Bayou, Tex | Houston Lighting & Power Co | Bechtel Corp | | | 39.9 | No | | | | | | |
| 5 | Westinghouse Electric Corp | Muncie, Ind | Indiana and Michigan Elect Co | | 7-61 | 301 | 30[4] | No | | | | | | |
| 6 | Midwest Steel Div, National Steel Corp | Porter, Ind | N Indiana Pub Serv Co | Swindell-Dressler | 10-61 | 750 | 30 | No | | | | | | |
| 7 | Dept of Airports, City of Los Angeles | Los Angeles, Cal | Dept of Water & Power | J S Hamel | 12-61 | 265 | 30 | No | | | | | | |
| 8 | Southwest Forest Industries, Inc | Snowflake, Ariz | Arizona Public Service Co | Rust Engrg Co | 11-61 | | 27 | No | | | | | | |
| 9 | The Babcock & Wilcox Co | Barberton, O | Ohio Edison Co | | 10-61 | 100 | 21.5 | 19.3 | .97 | No | 19.3 | 138 | 24,2.4 | 460 |
| 10 | Mack Trucks, Inc | Hagerstown, Md | Potomac Edison Co | Giffels & Rossetti, Inc | 1-62 | 270 | 13.2 | No | | | | | | |
| 11 | Goodyear Tire & Rubber Co | Los Angeles, Cal | L A Dept of Water & Power | Sargent & Lundy | 1962 | 77 | 13.2 | ...[7] | .94 | No | | 34.5 | 2.4, 460 | 2400 |
| 12 | The Goodyear Tire & Rubber Co | Beaumont, Tex | Gulf States Utility Co | | 3-62 | 500 | 10.8 | No | | | | | | |
| 13 | Monsanto Chemical Co | St Louis, Mo | Union Elect Co | Holabird & Root, Arch | 7-61 | | 10.1 | 2.88 | .90 | No | 2.88 | 34.5 | 4.16 | 208 |
| 14 | Eli Lilly & Co | Indianapolis, Ind | Indianapolis Power & Light Co | A M Kinney | 12-61 | 40 | 10 | 7.5 | .95 | 2.5 | 5 | 33 | 4.16 | 460Y/265 |
| 15 | AviSun Corp | New Castle, Del | Delaware Power & Light Co | Bechtel Corp | 6-61 | 214 | 9[10] | No | | | | | | |
| 16 | U S Post Office | Detroit, Mich | Detroit Edison Co | Giffels & Rossetti, Inc | 6-61 | ...[11] | 8.5 | No | | | | | | |
| 17 | Paterson Parchment Paper Co | Edgely, Pa | Philadelphia Electric Co | H M Wilson Co, Inc | 7-61 | | 7.37 | 4.77 | .90 | 2.1 | 2.67 | 34 | .460 | 460 |
| 18 | Sun Oil Co | Marcus Hook, Pa | Philadelphia Electric Co | | 1961 | 1300 | 6.35 | 3.5 | .95 | No | 3.5 | 13.2 | 2.4,13.2 | 2400,575 |
| 19 | Borg-Warner, Norge Div | Ft Smith, Ark | Oklahoma G & E Co | Giffels & Rossetti, Inc<br>Swain & Allen & Assoc | 7-61 | 22.5 | 6 | No | | | | | | |
| 20 | Armour & Co | Mason City, Ia | Interstate Power Co | | 11-61 | 2 | 5.8 | 2.4 | .85 | 1.25 | 1.15 | 4.16 | .460 | 440 |
| 21 | General Tire & Rubber Co | Mayfield, Ky | W Ky Rural Elec Coop Corp | H K Ferguson | 9-60 | 8 | 5 | No | | | | | | |
| 22 | Div of State Fair, State of Ill | Springfield, Ill | | Jenkins, Merchant & Nankivil | 3-61 | | 5 | No | | | | | | |
| PLANTS UNDER 5 MW | | | | | | | | | | | | | | |
| 23 | Westinghouse Electric Corp | Athens, Ga | Georgia Power Co | | 9-58 | 14.5 | 4.7 | No | | | | | | |
| 24 | Texas Industries, Inc | Midlothian, Tex | Texas P & L Co | Gable Elect Co | | 1500 | 4.67 | No | | | | | | |
| 25 | American Steel & Wire Co | Trenton, N J | Public Service E & G Co | | 3-61 | | 4.5 | 2.5 | .90 | No | 2.5 | 26.4 | 2.3, 460 | 460 |
| 26 | Western Electric Co | Greensboro, N C | Duke Power Co | | | 27 | 4.0[4] | 1.65 | | No | 1.65 | .480 | .460 | 460 |
| 27 | Foremost Food & Chemical Co | Oakland, Cal | Pacific G & E Co | Cal Electric Co | 4-61 | 4.5 | 4[4] | No | | | | | | |
| 28 | R J Reynolds Tobacco Co[14] | Winston-Salem, N C | Duke Power Co | Stone & Webster Engrg Corp | | | 4 | No | | | | | | |
| 29 | Bausch & Lomb, Inc | Rochester, N Y | Rochester G & E Co | Stone & Webster Engrg Corp | 6-61 | | 4 | No | | | | | | |
| 30 | Int'l Business Machines Corp | Yorktown Heights, N Y | Con Edison Co | Jaros, Baum & Bolles | 6-61 | | 3.5 | No | | | | | | |
| 31 | Armour & Co | Huron, S D | Interstate Power Co | | 8-61 | 2 | 3.3 | 1.1 | .85 | | 1.1 | 12.7 | .460 | 440 |
| 32 | Columbia Box Board Mills | Chatham, N Y | New York State E & G Corp | Alvin H Johnson & Co, Inc | 5-60 | 6 | 3.2 | 1.4 | .80 | .4 | 1 | 33 | | 460 |
| 33 | Dennison Mfg Co | Framingham, Mass | Boston Edison Co | Stone & Webster Engrg Corp | 4-61 | | 3.1 | 2.5 | .85 | No | 2.5 | 13.8 | 13.8 | 460 |
| 34 | Armour & Co | Bradley, Ill | Central Ill Pub Serv Co | Giffels & Rossetti Inc | 1-61 | 5 | 3 | No | | | | | | |
| 35 | Armour & Co | Houston, Tex | Texas Power & Light Co | Whyatt & Hedwrick | 7-61 | 3 | 3 | No | | | | | | |
| 36 | Armour & Co | San Francisco, Cal | | Utah Construction Co | 1961 | 1 | 3 | No | | | | | | |
| 37 | General Electric Co | Plainville, Conn | Connecticut L & P Co | Lockwood Greene Engrg Inc | 8-61 | .9 | 2.9 | 1.2 | .92 | No | 1.2 | 13.8 | .460 | 460 |
| 38 | Univ of North Carolina | Chapel Hill, N C | Duke Power Co | W C Olsen & Associates | 1962 | 10 | 2.85 | No | | | | | | |
| 39 | Bank for Savings Bldg | Birmingham, Ala | Alabama Power Co | James A Evans | 10-62 | 5.75 | 2.82 | No | | | | | | |
| 40 | United Technology Corp | Coyote, Cal | Pacific G & E Co | Parsons | 3-61 | 3200 | 2.7 | No | | | | | | |
| 41 | Norden Div, United Aircraft Corp | Norwalk, Conn | Connecticut L & P Co | Wigton-Abbott | 1961 | | 2.7 | No | | | | | | |
| 42 | American Pipe & Construction Co | Hayward, Cal | Pacific G & E Co | | 4-61 | 65 | 2.6 | 2 | .76 | No | 2 | .480 | .460 | 460 |
| 43 | Brandeis Investment Co | Omaha, Neb | | Leo A Daly Co | 10-60 | 35 | 2.4[4] | No | | | | | | |
| 44 | NW Lumber & Plywood Div, Crown Zellerbach Corp | Columbia City, Ore | Portland General Elect Co | | 11-60 | 381 | 2.2 | No | | | | | | |
| 45 | Diamond Crystal Salt Co | Akron, Ohio | None | Cummins & Barnard, Inc | 4-61 | | 2.1 | .85 | .85 | .85 | No | | .240 | 240 |
| 46 | W Waxide Div, Crown Zellerbach Corp | St Louis, Mo | Union Electric Co | Albert C Martin Co | 1960 | 26 | 2 | No | | | | | | |
| 47 | Veterans' Admin Hospital | Martinez, Cal | Pacific G & E Co | Williamson & Vollmer | 1963 | | 2[4] | No | | | | | | |
| 48 | Univ of California[17] | Berkely, Calif | Pacific G & E Co | Bayha, Weir & Finato | 1960 | | 1.9 | No | | | | | | |
| 49 | Kendall Co | Franklin, Ky | Elect Util Board of Franklin, Ky | Giffels & Rossetti, Inc | 5-62 | | 1.75 | No | | | | | | |
| 50 | Perfect Circle | Rushville, Ind | Pub Serv of Indiana, Inc | Giffels & Rossetti, Inc | 8-61 | | 1.75 | No | | | | | | |
| 51 | Patrician Paper Co | S Glens Falls, N Y | Niagara Mohawk Power Corp | Alvin H Johnson & Co, Inc | 9-61 | 4 | 1.6 | No | | | | | | |
| 52 | Armour & Co | Chicago, Ill | Commonwealth Edison Co | Epstein & Sons | 7-61 | | 1.5 | No | | | | | | |
| 53 | National Rejectors, Inc | Hot Springs, Ark | Arkansas P & L Co | Sverdrup & Parcel | 4-61 | 41 | 1.5 | No | | | | | | |
| 54 | Wm S Merrell | Cincinnati, Ohio | Cincinnati G & E Co | Wigton-Abbott | 1959 | 16 | 1.46 | 1.2 | .86 | No | 1.2 | 13.2 | 230,460 | 240,480 |
| 55 | Minneapolis-Honeywell | Golden Valley, Minn | Northern States Power Co | | | 105 | 1.2[4] | No | | | | | | |
| 56 | Children's Hospital | Birmingham, Ala | Alabama Power Co | James A Evans | 6-61 | | 1.1 | No | | | | | | |
| 57 | Papillon Creek Sewage Treatment Plant | Omaha, Neb | | Henningson, Durham & Richardson | 7-60 | 10 | 1[4] | No | | | | | | |
| 58 | American Dist Telegraph Bldg | Clifton, N J | Public Service E & G Co | Dwight Engrg Associates | 6-60 | 2.5 | .75 | No | | | | | | |
| 59 | Pyromet Co | San Carlos, Cal | Pacific G & E Co | Martineau & Aiken | 6-60 | 1 | .618 | No | | | | | | |
| 60 | N Salinas High School | Salinas, Cal | Pacific G & E Co | Buonaccorsi & Murray | 1959 | 45 | .5 | No | | | | | | |

1 - Zero-Gradient Synchrotron
2 - 1000 kva, 480 v; 3000 kva, 2.4 kv; 15,000 kva, 4.16 kv
3 - Circuit breakers at 34.5 kv load-break switches at 4.16 kv
4 - Initial demand not available. Estimated mw based on equipment capability
5 - Emergency only
6 - No new equipment
7 - Old and new load not separated
8 - Grounding transformers are used
9 - Kiloamperes
10 - Estimated
11 - 1,000,000 sq ft floor space
12 - Switching station
13 - Addition to existing substation
14 - Whitaker Park Steam Plant
15 - To 400 hp
16 - Drawout fused network protectors
17 - Lawrence Radiation Laboratory, 88" Cyclotron Building
18 - Grounding only on 240-120v dry transformer

AB - Allen-Bradley Co
ACM - Allis-Chalmers Mfg Co
ASW - American Steel & Wire Div, U S Steel Corp
AWC - Anaconda Wire & Cable Co
BE - Bulldog Electric Products Co
C - Clark Controller Co
CDE - Cornell-Dubelier Electric Corp
CE - California Electric Co
CH - Cutler-Hammer, Inc
Co - Continental Electric Co, Inc
CWC - Crescent Insulated Wire & Cable Co
De - Delco Products Div, General Motors Corp
EC - The Elliott Co
ECM - Electric Controller & Mfg Co
EDP - Electric Distribution Products Co
EEC - The English Electric Co, Ltd
EM - Electric Machinery Mfg Co
ES - The Electric Service Co, Inc

# distribution systems, new and modernized

| GENERATION (New Load) | | | | | UTILITY SUPPLIED NEW LOAD | | | PLANT VOLTAGES | | | | | PRIMARY SUBSTATION | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NEW UNITS | | | | | | | | | MOTOR VOLTAGE, V | | | | TRANSFORMERS | | | | | | |
| Total generating capacity, mw | Voltage, kv | No | PF | Manufacturer | Max mw | Avg pf | Kv | Distribution, kv | Utilization, v | 5-200 hp | 201-2000 hp | 200+ hp-upward | 265-v lights | Number of subs | Number each sub | Manufacturer | Impedance, % | Secondary neutral grounded | Circuit breaker 3-ph interrupting mva | Available s-c mva | Project Number |
| No | ..... | ..... | ..... | ..... | 50 | ..... | 132 | 13.2 | 460 | 440 | 2300 | 13,200 | No | 2 | 1,2 | WE, GE | ..... | Yes | ..... | 500 | 1 |
| No | ..... | ..... | ..... | ..... | 4 | .87 | 69 | 12 | 2400,460 | 440 | 2400 | ..... | No | No | ..... | ..... | ..... | ..... | ..... | ..... | 2 |
| No | ..... | ..... | ..... | ..... | 27 | .85 | 13.8 | 13.8 | 460,2400, 4160 | 440 | 2300 | 4000 | No | 20[2] | 1 | GE, ACM | ..... | Yes | ..... | ..... | 3 |
| No | ..... | ..... | ..... | ..... | 39.9 | .95 | 138 | 34.5,4.16 | 4160,460 | 440 | 4000 | 4000 | No | 1 | 2 | GE | 12.65 | Yes | 1500[3] | 895 | 4 |
| No | ..... | ..... | ..... | ..... | 30[4] | ..... | 138 | 13.8 | 460Y/265 | 440 | 440 | ..... | No | 1 | 2 | WE | 11.8 | No | 1000 | ..... | 5 |
| No | ..... | ..... | ..... | ..... | 30 | 1.0 | 138 | 13.8 | 4160 | 440 | 4000 | 13,200 | No | 1 | 2 | WE | 9.1 | Yes | 500 | 355 | 6 |
| .45[5] | .460 .480 | .050 .150 | .80 ..... | FM De | 30 | ..... | 34.5 | 34.5 | 460Y/265, 208Y/120 | 440 | 4000 | ..... | Yes | 9 | 2 | EEC | ..... | Yes | ..... | ..... | 7 |
| 25 | 13.8 | 25 | .80 | WE | 2 | .80 | ..... | 13.8 | 13.8 | 440 | 2300 | 13,200 | No | 2 | 1 | GE | ..... | Yes | 150 | ..... | 8 |
| No | ..... | ..... | ..... | ..... | 2.2 | .97 | 138 | 24,2.4 | 460 | 440 | ..... | ..... | No | 6 | ..... | ..... | ..... | ..... | ..... | ..... | 9 |
| No | ..... | ..... | ..... | ..... | 13.2 | .93 | 34.4 | 12.47,4.16 | 460Y/265 208Y/120 | 440 | 440,4000 | ..... | Yes | 1 | 3 | ITE | 6 | Yes | 250 | 109.5 | 10 |
| No | ..... | ..... | ..... | ..... | 7 | .94 | 2.4 | 2.4 | 2400 | 440 | 2300 | ..... | No | 1 | 3 | ..... | ..... | No | 150 | 107 | 11 |
| No | ..... | ..... | ..... | ..... | 10.8 | .90 | 69 | 2.4 | 2400,460 | 440 | 2300 | ..... | No | 1 | 2 | ACM | 9 | 8 | 150 | 30[9] | 12 |
| No | ..... | ..... | ..... | ..... | 7.2 | .90 | 34.5 | 4.16 | 4160,460 | 440 | 4000 | ..... | No | 1 | 2 | GE | 6 | Yes | 250[3] | 136 | 13 |
| No | ..... | ..... | ..... | ..... | 2.5 | .95 | 33 | 4.16 | 4160,460 | 440 | 4160 | ..... | Yes | 1 | 2 | WE | 6.3 | Yes | 250 | 124 | 14 |
| No | ..... | ..... | ..... | ..... | 9[10] | ..... | ..... | 13.8 | 460 | 440 | 2300 | ..... | No | 1 | 2 | GE | ..... | No | ..... | ..... | 15 |
| No | ..... | ..... | ..... | ..... | 8.5 | .85 | 4.8 | 4.8 | 460, 208Y/120 | 440 | 4600 | ..... | Yes | 12 | ..... | ..... | ..... | No | 500 | 300 | 16 |
| No | ..... | ..... | ..... | ..... | 2.6 | .90 | 4.16 | 4.16 | 460 | 440 | ..... | ..... | No | 1 | 1 | ITE | ..... | Yes | 250 | ..... | 17 |
| No | ..... | ..... | ..... | ..... | 2.85 | .95 | 13.2 | 2.4 | 2400,575 | 550 | 2300 | ..... | No | 13 | 13 | WE, GE | 5.5/6 | No | 50 | 48 | 18 |
| No | ..... | ..... | ..... | ..... | 6 | .80 | 66,12.5 | 12.5 | 460Y/265 | 440 | ..... | ..... | Yes | 1 | 1 | ..... | ..... | Yes | 250 | ..... | 19 |
| 1 | .480 | 1 | .85 | WE | 2.4 | .85 | .480 | .460 | 460 | 440 | ..... | ..... | No | 2 | 3,6 | ..... | ..... | Yes | 100[9] | 70[9] | 20 |
| No | ..... | ..... | ..... | ..... | 5 | .95 | 4.16 | 4.16 | 460 | 440 | 4160 | ..... | Yes | 1 | 3 | ACM | 7 | Yes | 250 | ..... | 21 |
| No | ..... | ..... | ..... | ..... | 5 | .80 | 4.16 | 4.16 | ..... | ..... | ..... | ..... | No | 1 | 6 | WE | ..... | Yes | ..... | ..... | 22 |
| No | ..... | ..... | ..... | ..... | 4.7 | .90 | 44 | 4.16 | 460 | 440 | 4160 | ..... | No | 1 | 2 | WE | ..... | Yes | 150 | ..... | 23 |
| No | ..... | ..... | ..... | ..... | 4.67 | .85 | 4.16 | 4.16 | 4160 | 440 | 4000 | ..... | No | 1 | 1 | WE | 6.1 | Yes | 250 | 11.2[9] | 24 |
| No | ..... | ..... | ..... | ..... | 2 | .95 | 26.4 | 2.3, 460 | 460 | 440 | 440, 2300 | ..... | Yes | 1 | 1 | ITE | 6 | No | ..... | ..... | 25 |
| No | ..... | ..... | ..... | ..... | 2.5[4] | ..... | ..... | ..... | ..... | 440 | ..... | ..... | No | 1 | 3 | GE | 5 | No | 50 | 39 | 26 |
| No | ..... | ..... | ..... | ..... | 4[4] | ..... | 12 | .460, 230 | 230,460 | 440 | ..... | ..... | No | 2 | 1 | P | ..... | Yes | ..... | ..... | 27 |
| No | ..... | ..... | ..... | ..... | 4 | .85 | 13.8 | 13.8 | 575 | 550 | 2300 | ..... | No | .... | ..... | ..... | ..... | ..... | ..... | ..... | 28 |
| No | ..... | ..... | ..... | ..... | 4 | .85 | 4.16 | 4.16 | 460 | 440 | ..... | ..... | Yes | 1 | 1 | ..... | ..... | Yes | ..... | ..... | 29 |
| No | ..... | ..... | ..... | ..... | 3.5 | .80 | 13.8 | 13.8 | 260Y/265, 208Y/120 | 440[15] | ..... | ..... | Yes | 1[12] | ..... | ..... | ..... | ..... | 500 | 12.5[9] | 30 |
| No | ..... | ..... | ..... | ..... | 1.2 | .85 | .480 | .460 | 460 | 440 | ..... | ..... | No | 1 | 3 | ..... | ..... | No | 100[9] | 90[9] | 31 |
| ..... | ..... | ..... | ..... | ..... | 1.8 | .90 | 33 | .460 | 460 | 440 | ..... | ..... | No | 1 | 1 | GE | 6 | No | 75 | ..... | 32 |
| No | ..... | ..... | ..... | ..... | .6 | .85 | 13.8 | 13.8 | 460 | ..... | ..... | ..... | No | 1 | 1 | ITE | 5.5 | No | 50[9] | 30[9] | 33 |
| No | ..... | ..... | ..... | ..... | 3 | ..... | ..... | 4.16 | 460 | 440 | ..... | ..... | No | 1 | 1 | ..... | ..... | Yes | 100 | 70[9] | 34 |
| No | ..... | ..... | ..... | ..... | 3 | ..... | 12.7 | 4.16 | 460 | 440 | ..... | ..... | No | 0 | ..... | ..... | ..... | ..... | 100[9] | ..... | 35 |
| No | ..... | ..... | ..... | ..... | 3 | .85 | .480 | .460 | 460 | 440 | ..... | ..... | No | 1 | 3 | ..... | ..... | ..... | 100[9] | ..... | 36 |
| No | ..... | ..... | ..... | ..... | 1.7 | .90 | 13.8 | .460 | 460 | 440 | ..... | ..... | No | 1 | 1 | GE | 5.7 | Yes | 500 | ..... | 37 |
| 12.5 | ..... | 12.5 | .80 | ..... | 16 | .80 | 7.2 | 2.4 | 2400 | 220, 2300 | ..... | ..... | No | 1 | 6 | WE | ..... | No | ..... | ..... | 38 |
| No | ..... | ..... | ..... | ..... | 2.82 | ..... | .480 | .460Y/.265 | 460Y/265 | 460 | ..... | ..... | Yes | .... | ..... | ..... | ..... | ..... | ..... | ..... | 39 |
| No | ..... | ..... | ..... | ..... | 2.7 | .90 | 12 | 12 | 460 | 440 | ..... | ..... | No | 1 | 3 | ..... | ..... | ..... | ..... | ..... | 40 |
| No | ..... | ..... | ..... | ..... | 2.7 | .90 | 28.8 | 4.16 | 460 | 440 | ..... | ..... | Yes | 1 | 1 | GE | 5 | No | 150 | 83 | 41 |
| No | ..... | ..... | ..... | ..... | .6 | .75 | .480 | .460 | 460 | 440 | ..... | ..... | .... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 42 |
| No | ..... | ..... | ..... | ..... | 2.4[4] | ..... | ..... | .460 | 265 | ..... | ..... | ..... | Yes | 1 | 6 | ITE | 6.13 | Yes | 24 | 50[9] | 43 |
| No | ..... | ..... | ..... | ..... | 2.2 | .70 | 11.4 | 11.4 | 460 | 440 | ..... | ..... | Yes | .... | ..... | ..... | ..... | ..... | ..... | ..... | 44 |
| 1.25 | .240 | 1.25 | .80 | WE | No | ..... | ..... | .480, .240 | 240,480 | 220 | 440 | ..... | No | .... | ..... | ..... | ..... | ..... | ..... | ..... | 45 |
| No | ..... | ..... | ..... | ..... | 2 | .80 | 12.47 | 12.47 | 460 | 440 | ..... | ..... | Yes | No | ..... | ..... | ..... | ..... | ..... | ..... | 46 |
| .75[5] | .480Y/.277 | .75 | .80 | ..... | 2[4] | .80 | 12 | .460Y/.265 | 120/208 | ..... | ..... | ..... | Yes | 2 | 2 | ..... | ..... | Yes | 16 | ..... | 47 |
| No | ..... | ..... | ..... | ..... | 1.9 | .95 | 12 | .460 | 460 | 440 | ..... | ..... | No | 1 | 1 | GE | ..... | Yes | ..... | ..... | 48 |
| No | ..... | ..... | ..... | ..... | 1.75 | .90 | 13.2 | 13.2 | 460 | 440 | ..... | ..... | Yes | 1 | ..... | ..... | ..... | Yes | 250 | 48 | 49 |
| No | ..... | ..... | ..... | ..... | 1.75 | .90 | 12.5 | 12.5 | 460 | 440 | ..... | ..... | Yes | 1 | ..... | ..... | ..... | Yes | 250 | 36 | 50 |
| No | ..... | ..... | ..... | ..... | 1.6 | .85 | 33 | .460 | ..... | 440 | ..... | ..... | No | 1 | 1 | GE | 6 | No | 75 | ..... | 51 |
| No | ..... | ..... | ..... | ..... | 1.5 | ..... | ..... | .460 | 460 | 440 | ..... | ..... | No | 1[12] | 0 | ..... | ..... | ..... | 100[9] | ..... | 52 |
| No | ..... | ..... | ..... | ..... | 1.5 | ..... | .480 | .460Y/.265 | 460 | 440 | ..... | ..... | Yes | 1 | 3 | WE | ..... | Yes | 50[9] | 38[9] | 53 |
| No | ..... | ..... | ..... | ..... | .26 | .87 | 13.2 | .208/.177 | 208 | 208 | ..... | ..... | No | 1 | 1 | GE | 5 | Yes | 50 | ..... | 54 |
| No | ..... | ..... | ..... | ..... | 1.2[4] | ..... | ..... | .460Y/.265 | 460 | 440 | 440 | ..... | Yes | 3 | 2,1 | WE | 5.75 | Yes | ..... | ..... | 55 |
| No | ..... | ..... | ..... | ..... | 1.1 | ..... | .208 | .208Y/.120 | 208 | 208 | ..... | ..... | No | .... | ..... | ..... | ..... | ..... | ..... | ..... | 56 |
| No | ..... | ..... | ..... | ..... | 1[4] | ..... | 13 | 13 | 460 | 440 | 440 | ..... | No | 1 | 3 | GE | 5.2 | No | ..... | 4.6[9] | 57 |
| No | ..... | ..... | ..... | ..... | .75 | .75 | 4.16 | .240 | 230 | ..... | ..... | ..... | No | 1 | 3 | ..... | ..... | No[18] | 150[9] | 46[9] | 58 |
| No | ..... | ..... | ..... | ..... | .618 | .96 | .480 | .460 | 460 | 440 | ..... | ..... | Yes | 1 | 1 | ACM | ..... | Yes | ..... | ..... | 59 |
| No | ..... | ..... | ..... | ..... | .5 | ..... | 12 | .460Y/.265 | 460 | ..... | ..... | ..... | Yes | 1 | 1 | Ku | ..... | Yes | ..... | ..... | 60 |

EW - Essex Wire Corp
FM - Fairbanks, Morse & Co
FP - Federal Pacific Electric Co
GC - General Cable Co
GE - General Electric Co
GG - Gavin Graham Co
GM - General Motors Corp
He - Hendrix Wire & Cable Corp
IE - Ideal Electric & Mfg Co

ITE - I-T-E Circuit Breaker Co
K - Kaiser Aluminum & Chemical Sales, Inc
Ke - Kerite Co
Ki - Kirkhof Electric Co
Ku - Kuhlman Electric Co
LA - The Louis Allis Co
LM - Line Material Co
ME - Marathon Electric Co
Mo - Moloney Electric Co

Mu - Mullenbauch Co
N - Niagara Transformer Co, Inc
Ok - The Okonite Co
P - Pennsylvania Transformer Co
Pa - Paranite Co
PD - Phelps Dodge Copper Products Corp
PE - Penn Electric Co
RC - Rowan Controller Co
RE - Reliance Electric & Engineering Co

Re - Rockbestos Products Corp
RS - J A Roebling's Sons Corp
SC - S & C Electric Co
SD - Square D Co
SE - Sprague Electric Co
So - Sorgel Electric Co
ST - The Standard Transformer Co
Su - Superior Cable Corp

SW - Simplex Wire & Cable Co
T - Trumbull Components Dept, General Electric Co
TCC - Triangle Conduit & Cable Co
Up - R E Uptegraff Mfg Co, Inc
USM - United States Motors Corp
W - Wagner Electric Corp
WE - Westinghouse Electric Corp

# Electrical design features continued

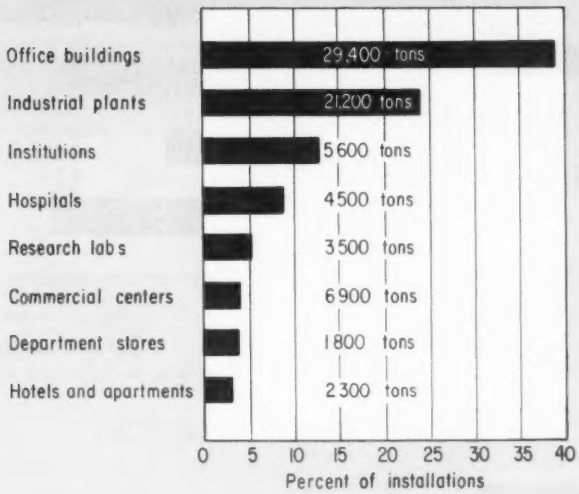
Compiled by:
Norman Peach, Associate Editor

| Project Number | PRIMARY SUBSTATION (Cont.) | | | | PRIMARY DISTRIBUTION (ABOVE 600 v) | | | | SECONDARY SUBSTATIONS | | | | | SECONDARY DISTRIBUTION | | | UTILIZATION | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | TOTAL LOAD DIVISION | | | | | Total motor hp | Motor manufacturer(s) | MOTOR CONTROL | | Capacitors, kvar | Lighting type |
| | Switchgear Manufacturer | Ultimate sub capacity, mva | Ownership | Meter location | Circuitry | Overhead or underground | Distribution means | Cable manufacturer | Number | Unit sub manufacturer | Transformer type | Manufacturer | Secondary neutral grounded | Means | Busway manufacturer | Cable manufacturer | Lighting, % | Motors, % | Welding, % (Supply capacity) | Heat and process, % | Dc, % | | | Centralized or local | Control manufacturer(s) | | |
| 1 | ACM | 87.5[19] | S | Sec | Ps | Un | IA | Var | 20 | ITE | Oil,Dry | ITE | Yes | IA,TC,CC | ..... | Var | 7.4 | 37 | 0 | 0 | 55.6 | 25,000 | Var | Cen | ACM,GE | ..... | F,M |
| 2 | ..... | ..... | ... | ..... | Ra | Ov | AC | ..... | 3 | ACM,WE | Oil | ..... | No | CC | ..... | ..... | 1 | 99 | ... | ... | .... | 4500 | ACM,WE | Cen | ..... | ..... | I |
| 3 | GE | ..... | U | Sec | Ra | Ov | IA,AC | ..... | ... | ..... | ..... | ..... | ..... | IA,TC | ..... | GE,SW | .... | .... | ... | ... | .... | ..... | WE,GE,EM, RE,EEC | Cen | GE | ..... | M,F,I |
| 4 | WE | 120 | S | Pri | Ra,Ps[20] | Ov | AC,IA[20] | GC,K,PD | 17[21] | ITE | Ask | ITE | Yes | CC | ..... | AWC | .... | .... | ... | ... | .... | ..... | ..... | ..... | GE | ..... | I |
| 5 | WE | 50 | S | Sec | PS | Ov | TC | ..... | 11 | WE | Dry | WE | ..... | PB | WE | ..... | 6 | .... | ... | ... | .... | ..... | WE | Loc | WE | ..... | F,M |
| 6 | WE | 160 | S | Pri | Ra,Ps,SS | Un | IA | PD | 6 | WE | Ask | WE | Yes | CC,TC | ..... | TCC | 1.1 | 81.9 | 13.3 | .2 | 3.5 | 86,000 | GE,WE, ACM,RE | Cen | GE,WE,C, ACM,ECM | ..... | F,I,M |
| 7 | WE | 3 | D | Sec | No | Un | CC | EEC | No | ..... | ..... | ..... | ..... | CC | ..... | ..... | 62 | 38 | ... | ... | .... | ..... | ..... | Cen | ..... | ..... | F,I,M |
| 8 | GE | 5 | S | Sec | Ra | Ov | IA | GE | 13 | GE | Oil | GE | Yes | IA | ..... | GE | .5 | 94.5 | ... | ... | 5 | 40,000 | GE | Cen | GE | ..... | F,I,M |
| 9 | ..... | ..... | ... | ..... | No | Ov | AC | GE | 3 | WE,P | Ask | ..... | Yes | CC | ..... | GE | 10 | 40 | 20 | 30 | .... | 1800 | GE,LA | Loc | AB,CH | ..... | F |
| 10 | ITE | ..... | S | Pri | PS | Ov | IA | Ke | 14 | ITE | Dry | ITE | Yes | IA,CC | EDP | AWC | 23 | 27 | 50 | ... | .... | 5700 | GE,FM,RE | Cen | GE | 4560 | F,I |
| 11 | WE | 25 | U | Sec | Ra | Ov | IA,CC | ..... | 10 | ..... | Ask | ..... | Yes | IA,CC | ..... | ..... | 8 | 86 | ... | ... | 6 | ..... | Var | Cen | SD | ..... | F |
| 12 | GE | 18.75 | U | Pri | Ra | Ov | IA | ..... | 10 | GE | Ask | ..... | No | IA,CC | ..... | ..... | 10 | 75 | 5 | ... | 10 | 16,000 | ACM | Loc | GE | ..... | F,I |
| 13 | GE | 30/37.5 | U | Sec | PS | Un | CD | AWC,PD | 5 | GE | Dry | GE | Yes | CC,PB | ..... | ..... | 25 | 50 | 25 | ... | .... | 6500 | GE | Cen | GE | ..... | F |
| 14 | WE | 15 | S | Pri | PS | Un | CC | Ke | 2 | ITE | Ask | ITE | Yes | CC | ..... | CWC,GC, SW | 10 | 90 | ... | ... | .... | 3000 | IE,GE,WE, ACM,LA | Both | GE,AB, WE | 720 | F,I |
| 15 | GE | 20 | S | Pri | PS | Both | CC | Ok | 15 | WE | Oil | WE | No | CC | ..... | GE,GC, Ok | 5 | 70 | 25 | ... | .... | 14,000 | GE,WE, LA,RE | Loc | GE,SD | ..... | F,I |
| 16 | GE | ..... | U | Pri | PS | Ov | CC | AWC | 4 | GE | Dry | GE | Yes | PB,CC | GE | AWC | 30 | 30 | 40 | ... | .... | 5000 | GE,EM | Both | GE | ..... | F |
| 17 | ITE | 3.13 | S | ..... | Ra | Un | IA | PD | 3 | ITE | Ask | ITE | No | CC | ..... | ..... | .... | .... | ... | ... | .... | ..... | ..... | ..... | ..... | ..... | ..... |
| 18 | WE,GE | 12 | S | Pri | Ra | Un | CC | Var | No | ..... | ..... | ..... | ..... | CC | ..... | Var | 5 | 90 | 5 | ... | .... | 4000 | GE,WE,CO | Loc | GE,WE,RE | 200 | F,I,M |
| 19 | ITE | 22.5 | U | Pri | Ra | Ov | IA | Ok | 5[22] | ITE | Ask | ITE | Yes | PB,IA | BE | Ok | 32 | .... | 20 | ... | .... | ..... | ..... | Loc | ..... | ..... | F,I[23] |
| 20 | WE | 4.5 | U | Pri | Ra | Both | CC | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 10 | 70 | 20 | ... | .... | 3500 | ACM | Loc | ..... | ..... | F,I |
| 21 | GE | 10 | D | ..... | Ra | Ov | IA | ..... | 4 | P | Oil | ..... | Yes | PB,IA,CC | ..... | Var | 10 | 70 | 10 | ... | 10 | ..... | GE | Cen | WE | 500 | F |
| 22 | FP | 6 | S | Sec | Ne | Un | CC | GC | 7 | FP | Dry | FP | Yes | PB | SD | GC | .... | .... | ... | ... | .... | ..... | ..... | ..... | ..... | ..... | ..... |
| 23 | WE | 7.5 | D | Sec | PS | Ov | IA | ..... | 9 | WE | Dry | WE | Yes | PB,IA | WE | ..... | 31 | .... | ... | ... | .... | ..... | ..... | Loc | WE | ..... | F,M |
| 24 | ACM | ..... | U | Sec | Ra | Un | CC | GE,Su | 6 | ACM | Ask | ACM | Yes | CC | ..... | GE,Su | 5 | 95 | ... | ... | ....[25] | 8000 | GE,EM,ACM | Cen | ACM | ..... | F,I |
| 25 | ITE,GE | 1.5 | S | Sec | ..... | Ov | CC | ASW | 1 | GE | Oil | GE | No[24] | CC | ..... | ASW | 15 | 80 | 5 | ... | 80[25] | 2400 | RE | Cen | RE,C | ..... | F,I |
| 26 | GE | 2.5 | U | Sec | ..... | ... | ..... | ..... | ... | ..... | ..... | ..... | ..... | PB,IA,CC | SD | Var | 30 | 30 | 40 | ... | .... | ..... | Var | Loc | ..... | ..... | F,I,M |
| 27 | CE | ..... | S | Pri | SS | Un | ..... | GC | No | ..... | ..... | ..... | ..... | CC | ..... | GC | 20 | 55 | 20 | 5 | .... | ..... | Var | Cen | CE | ..... | F,I |
| 28 | ..... | ..... | ... | ..... | PS | Ov | AC | AWC,Ok | 3 | WE | Ask | WE | Yes | CC,TC | ..... | Var | 2.2 | 97.8 | ... | ... | .... | 5,510 | GE,WE,LA | Cen | WE | ..... | F,I,M |
| 29 | ..... | ..... | U | Sec | Ra | Ov | IA | ..... | 4 | ITE | Dry | ITE | Yes | PB | GE | ..... | 10 | 80 | 10 | ... | .... | ..... | ..... | Loc | GE,WE | ..... | F |
| 30 | GE | ..... | S[12] | Pri | PS | Un | CC | GE | 7 | GE | Dry | GE | Yes | PB,CC | GE | Ok | 30 | 40 | 30[26] | ... | .... | 2065 | ..... | Cen | CH | ..... | F,I |
| 31 | ITE | 3 | U | ..... | Ra | Ov | CC | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 10 | 70 | 20 | ... | .... | 3000 | ACM | Loc | ..... | ..... | I |
| 32 | GE | 3 | S | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 10 | 90 | ... | ... | .... | ..... | ..... | Loc | ..... | ..... | F,I |
| 33 | ITE | 1.5 | S | Pri | PS | Un | CC | SW | ... | ..... | ..... | ..... | ..... | CC,PB | ..... | ..... | 10 | 90 | ... | ... | .... | ..... | ..... | Loc | ..... | ..... | F |
| 34 | ITE | 4.5 | U | Pri | SS | Ov | CC | ..... | 4 | ITE | Dry | ..... | ..... | PB,IA | WE | ..... | 70 | 15 | ... | ... | 15 | 200 | ..... | Loc | ..... | ..... | F |
| 35 | GE | ..... | ... | Pri | ..... | Ov | CC | ..... | 3 | FP | Dry | FP | Yes | CC | ..... | ..... | 10 | 60 | 30 | ... | .... | 4000 | ACM | Cen | ACM | ..... | F,I |
| 36 | ..... | ..... | U | ..... | Ra | Ov | CC | ..... | No | ..... | ..... | ..... | ..... | CC | ..... | ..... | 10 | 70 | 20 | ... | .... | 4000 | ACM | Both | GE | ..... | I,F |
| 37 | GE | ..... | S | Pri | ..... | Un | IA | GE | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 10 | 70 | 20 | ... | .... | 3000 | ..... | ..... | ..... | ..... | F,I |
| 38 | WE | 3 | S | Sec | Ra | Ov | ..... | ..... | 1 | GE | Oil | GE | No | PB | GE | ..... | 35 | 55 | ... | 10 | .... | ..... | ..... | Loc | GE | ..... | F |
| 39 | ..... | ..... | U | ..... | ..... | ..... | ..... | ..... | 8 | ..... | Dry | ..... | No | CC | ..... | Ok | 5 | 95 | ... | ... | .... | 1600 | WE,GE | Loc | WE,GE | ..... | F,I |
| 40 | WE | 8 | S | ..... | Ra | Ov | ..... | Ok | 15 | WE | Oil | WE | Yes | PB,CC,TC | ..... | ..... | 32 | 68 | ... | ... | .... | 2050 | ..... | Cen | ..... | ..... | F,I |
| 41 | GE | 6.5 | S | Pri | SS | Un | CC | PD | 3 | GE | Dry | GE | Yes | CC | ..... | AWC | 20 | 30 | 50 | ... | .... | ..... | USM | ..... | SD,GE,WE | ..... | F,I,M |
| 42 | ..... | ..... | ... | ..... | ..... | Un | CC | ..... | No | ..... | ..... | ..... | ..... | PB,CC | T | PD,TCC | 40 | 50 | 10 | ... | .... | 2500 | Var | Both | GE,AB | ..... | F,I,M |
| 43 | WE | 7.5 | D | Sec | ..... | ... | ..... | ..... | 3 | WE | Dry | WE | Yes | ..... | ..... | ..... | 5 | 65 | ... | 25 | .... | 450 | Var | Loc | ..... | ..... | I |
| 44 | ..... | ..... | ... | ..... | Ra | .... | CC | ..... | 3 | ACM | Dry | ACM | Yes | PB,CC | WE | GC | 80 | 20 | ... | ... | .... | 650 | ..... | Cen | WE | ..... | F,I,M |
| 45 | ..... | ..... | ... | ..... | ..... | ... | ..... | ..... | 1 | WE | Dry | WE | No | CC | ..... | GE | 15.5 | 84.5 | ... | ... | .... | 3616 | RE | Cen | WE | ..... | F,I |
| 46 | ..... | ..... | ... | ..... | Ra | Ov | CC | ..... | 5 | WE | Ask | WE | Yes | CC | ..... | ..... | 23 | 73.4 | 2.6 | ... | .... | 2787 | ..... | Cen | WE | ..... | F,I |
| 47 | ..... | ..... | S | Pri | Ne | Un | CC | ..... | ... | ..... | ..... | ..... | ..... | CC | ..... | ..... | 50 | 50 | ... | ... | .... | ..... | ..... | Both | ..... | ..... | F,I |
| 48 | GE | 4 | S | Pri | Ra | Un | CC | ..... | 3 | GE,ST | Oil,Dry | GE,ST | Yes | CC,TC | ..... | ..... | ... | ... | ... | ... | .... | ..... | ..... | Both | GE | ..... | F,I,M |
| 49 | WE | ..... | S | Pri | Ra | Ov | ..... | ..... | 1 | WE | Dry | WE | Yes | PB,CC | WE | ..... | 23 | 77 | ... | ... | .... | 2500 | ..... | Loc | ..... | ..... | F |
| 50 | ACM | ..... | S | Pri | Ra | Un | CC | ..... | 1 | ITE | Ask | ITE | Yes | ACM | BE | ..... | 15 | 70 | 15 | ... | .... | 2000 | ..... | Both | AB,Ki | 280 | F,M |
| 51 | GE | 3 | S | Pri | ..... | ... | ..... | ..... | ... | ..... | ..... | ..... | ..... | IA,CC,TC | ..... | ..... | 10 | 90 | ... | ... | .... | ..... | ..... | Cen | ..... | ..... | F,I |
| 52 | SD | ..... | S[12] | ..... | Ra | .... | CC | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 20 | 70 | 10 | ... | .... | 2000 | ACM | Loc | ..... | ..... | F,I |
| 53 | WE | ..... | U | Pri | ..... | ... | ..... | ..... | ... | ..... | ..... | ..... | ..... | PB | WE | ..... | 20 | 60 | 5 | 15 | .... | ..... | ..... | Loc | ..... | ..... | F |
| 54 | GE,ITE | .3 | S | Sec | PS | Un | DB | ..... | ... | GE | Ask | GE | Yes | CC | ..... | ..... | ... | ... | ... | ... | .... | ..... | LA | Loc | AB | ..... | F |
| 55 | WE | ..... | S | Sec | PS | Un | DB | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | .... | .... | ... | ... | .... | ..... | ..... | ..... | ..... | ..... | ..... |
| 56 | ..... | ..... | ... | ..... | ..... | ... | ..... | ..... | No | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 28 | 60 | ... | ... | .... | 665 | ..... | Cen | ..... | ..... | F,I |
| 57 | ..... | ..... | U | Sec | ..... | ... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 20 | 60 | 20 | ... | .... | ..... | Var | Cen | Var | ..... | F,I |
| 58 | GG | 1 | U | Sec | ..... | ... | ..... | ..... | ... | ..... | ..... | ..... | ..... | PB | BE | ..... | 63 | 37 | ... | ... | .... | ..... | ..... | Loc | ..... | ..... | F |
| 59 | WE | 1.5 | D | Sec | ..... | ... | ..... | ..... | 3 | WE | Dry | WE | Yes | PB,CC | WE | ..... | 8 | 5 | 82 | 5 | .... | 80 | Var | Loc | Var | ..... | F,M |
| 60 | Mu | .5 | S | Sec | ..... | Un | CC | ..... | 6 | Mu | Dry | Up | Yes | CC | ..... | ..... | .... | .... | ... | ... | .... | ..... | ..... | Cen | ..... | ..... | F,I |

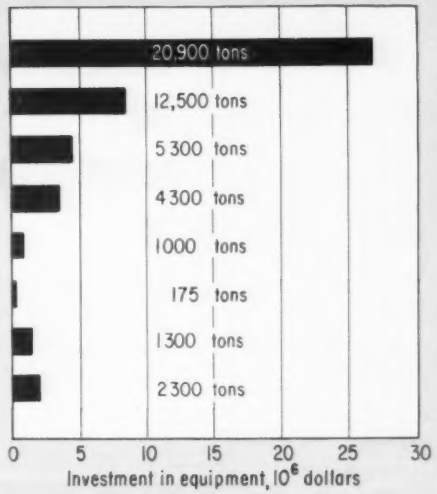
For key to manufacturers see preceding pages

12 - Switching station
19 - Combined
20 - At 34.5 kv: PS, open wire. At 4.16 kv: Ra, spaced cable
21 - 4 at 34.5-4.16 kv; 13 at 4.16-.480 kv
22 - Double-ended
23 - 5% quartz iodine
24 - Delta
25 - Motor load
26 - Laboratory power
AC - Aerial cable
Ask - Askarel
CB - Circuit breaker
CC - Cable and conduit
CD - Cable and duct
Cen - Central
D - Divided ownership
DB - Direct Burial
F - Fluorescent
I - Incandescent
IA - Interlocked armored cable
Loc - Local
M - Mercury-vapor
MI - Mineral-insulated cable
Ne - Network
Ov - Overhead
PB - Plug-in busway
Prl - Primary
PS - Primary selective
Ra - Radial
S - Self ownership
Sec - Secondary
SS - Secondary selective
TC - Trough and cable
U - Utility ownership
Un - Underground
Var - Various

## WHERE UNITS ARE INSTALLED

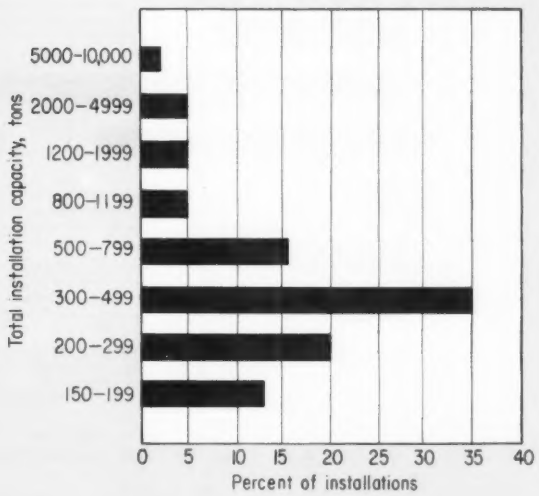



## INVESTMENT IN EQUIPMENT



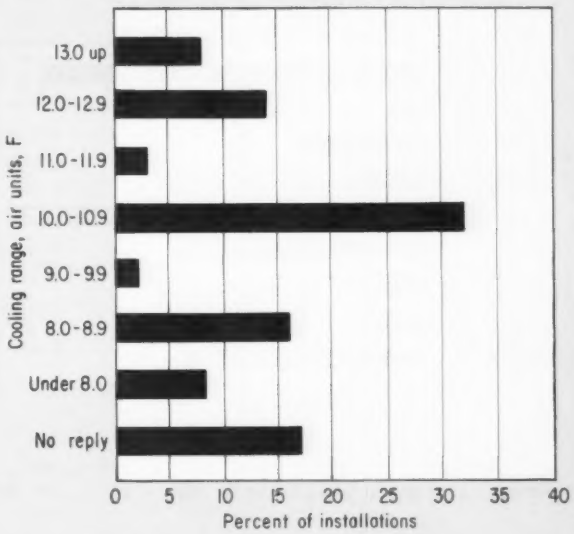

**OFFICE BUILDINGS** still lead in number of air-conditioning installations, take largest chunk of investment in equipment

## TONNAGE RANGE




**REFRIGERATION-CAPACITY** distribution shows cluster in the 200- to 799-ton ranges. Over 70% of the returns fall in this area

## HEAT-TRANSFER RANGE




**A 10-DEGREE** water-temperature rise through coils is most prevalent, followed by 8 and 12 degrees to account for 68% of returns

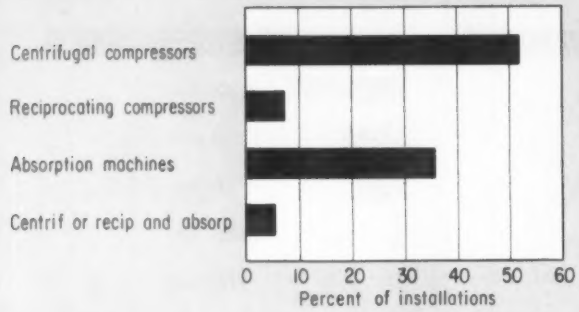
# AIR CONDITIONING continues spectacular growth

Installed cost of central-station air-conditioning systems put into operation during 1960 is estimated at over $800 million by the Air Conditioning & Refrigeration Institute. This exceeds 1959 by more than $84 million and is almost quadruple the value of systems installed just ten years ago. POWER's third annual survey reports the design features of 116 new commercial, industrial and institutional air-conditioning systems.

For the first time, we've asked for dollar-value amounts invested in air-conditioning equipment. Not all plants were able to divulge this information, but systems representing 45,800 tons out of the 73,200 tons covered in the survey report a total investment in excess of $48 million. Industrial-plant air conditioning continues to grow, is now second only to office buildings in total capacity and investment. Yet, less than 10% of all factories are now air conditioned, emphasizing the vast potential for future growth in this area.

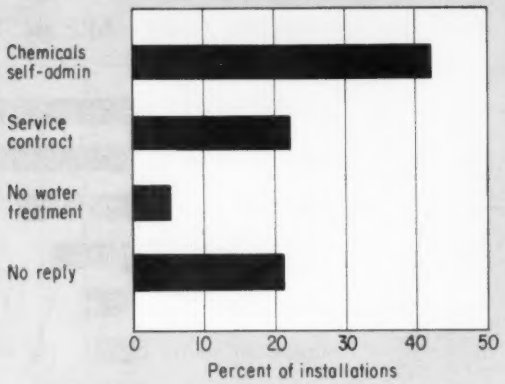
**continued**

## REFRIGERANT-MACHINE TYPES



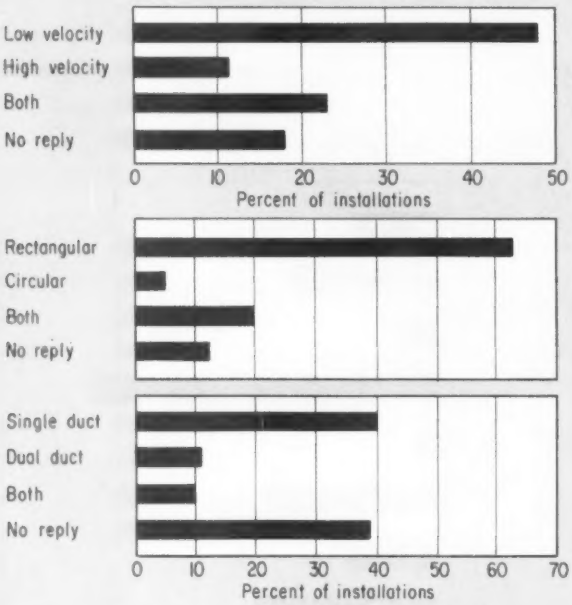

**ABSORPTION MACHINES continue to gain in popularity as number of units jumps from 17% last year to present 36% of survey returns**

## WATER TREATMENT



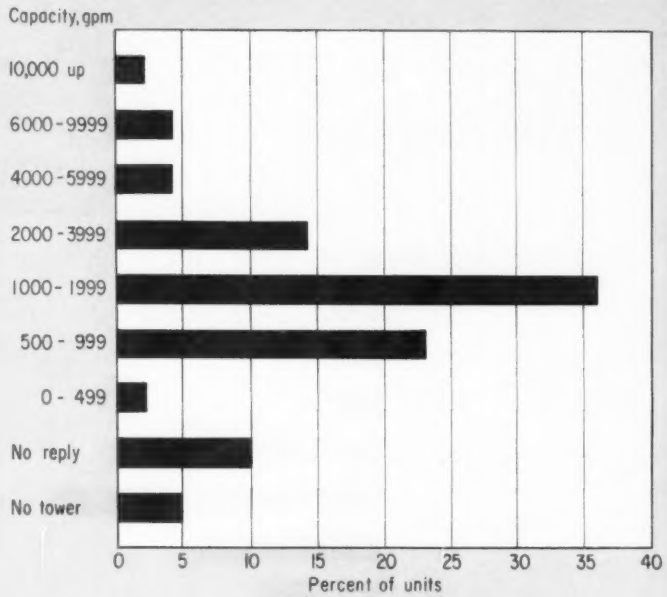

**SERVICE CONTRACTS gain on self-administered chemicals. Only 5% report no treatment, but a large group has not yet made a decision**

## DUCT SYSTEM



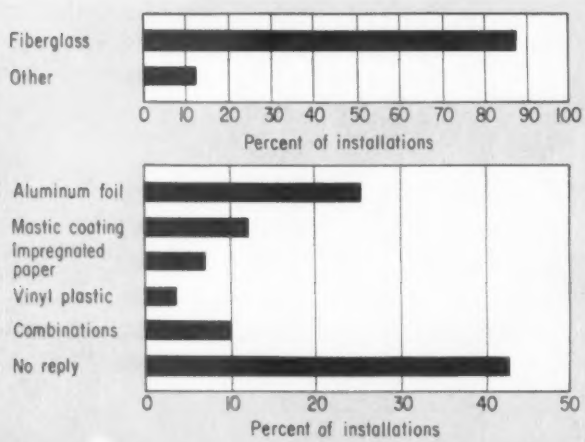

**COOLING-TOWER-CAPACITY distribution centers in 1000- to 1999-gpm category. Over 70% of towers fall in the range of 500 to 3999 gpm**

## COOLING-TOWER SIZES



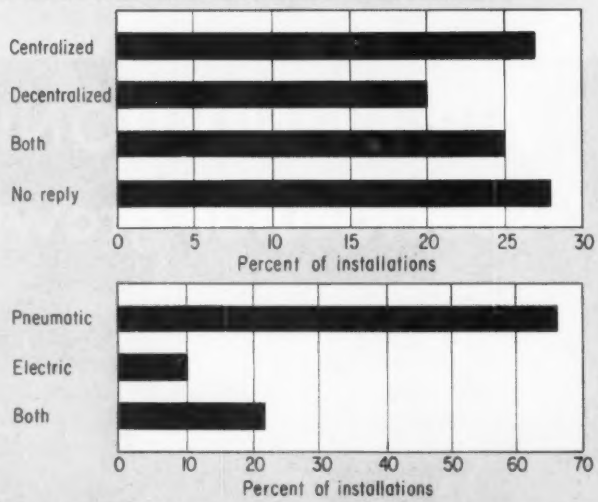

**LOW-VELOCITY, rectangular, single-duct systems are employed on over half of installations in survey. Dual-duct design also gains**

## INSULATION—VAPOR SEAL




**FIBERGLASS board and blanket see heavy duty. Aluminum foil again wins top place as vapor-seal material—next in line is mastic coating**

## INSTRUMENTATION AND CONTROL




**CENTRALIZED CONTROL systems are on upswing. Well over half of installations responding have some form of centralized control**

**Table 1**

# 1961 air-conditioning survey

Each listing covers 3 pages. Project number helps you track a specific installation after you turn facing page

| Project Number | Company | Location | Consulting Engineer | Contractor | New or existing plant | Date of initial operation | SYSTEM: Total cooling load, tons | SYSTEM: Conditioned space, area, 1000 sq ft | SYSTEM: System type | SYSTEM: Manufacturer | SYSTEM: Installed in |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Exchange Park Co | Dallas, Texas | Blum & Guerrero[1] | Kieffer Plbg & Htg[2] | Ex | 1960 | 5500[3] | ..... | Cen | YO,WO | Cmr |
| 2 | Union Carbide Corp | New York, N Y | Syska & Hennessy Inc | Kerby Saunders Inc | ..... | ..... | 5000 | 1500 | Cen | WO | OB |
| 3 | Argonne National Lab[9] | Argonne, Ill | Sverdrup & Parcel | | New | 1962 | 4012.65[10] | 104.3 | Cen | ..... | IP |
| 4 | Prudential Ins Co of America | Newark, N J | Voorhees Walker Smith Smith & Haines | Kerby Saunders Inc | New | 1960 | 3020 | 600 | Cen | YO | OB |
| 5 | U S Post Office | Detroit, Mich | Giffels & Rossetti | Barton-Malon Co | New | 1961 | 2400 | 730 | Cen | WO | OB, IP |
| 6 | Western Electric Co, Inc | New York, N Y | Meyer, Strong & Jones | Kerby Saunders Inc | New | 1961 | 2250 | 540 | Cen | YO,TR | OB |
| 7 | Westinghouse Electric Corp | Beuhla Rd, Pittsburgh, Pa | ..... | ..... | ..... | ..... | 2250 | 400 | Plkg,Cen | WE | Lab |
| 8 | Pfizer Building | New York, N Y | Cosentini Assoc | Raisler Corp | New | ..... | 2150 | 512 | Cen | WO | OB |
| 9 | 215 E 68 St Apt House | New York, N Y | Rutherford L Stinard | H Sand & Co, Inc | New | 1962 | 1575 | 1750 | Cen,Ab | CC | Apt |
| 10 | United Aircraft Corp, Norden Div | Norwalk, Conn | Wigton Abbott | Wigton-Abbott | New | 1961 | 1500 | 300 | Cen,Ab | CC | IP |
| 11 | U S Atomic Energy Com, Phase II | Kansas City, Mo | Burns & McDonnell Engrg Co | Natkin & Co | Ex | 1961 | 1400 | 147.1 | Cen,Com,Ab[14] | CC | IP |
| 12 | Avondale Mills | Sylacauga, Ala | James A Evans | The Bahnson Co | Ex | 1961 | 1330 | 109 | Cen | CC | IP |
| 13 | U S Atomic Energy Com, Phase I | Kansas City, Mo | Burns & McDonnell Engrg Co | Natkin & Co | Ex | 1961 | 1200 | 144 | Com,Ab[14] | YO | IP |
| 14 | Southwest Texas Methodist Hospital | San Antonio, Texas | George Rhine & Co | Todd-Ford Ltd | New | 1962 | 1200 | ..... | Cen | TR | Hosp |
| 15 | Bethlehem Steel Bldg | San Francisco, Calif | Dudley Dean & Assoc | Scott Co | New | 6-61 | 1100 | 275 | Cen,CO | YO | OB |
| 16 | Federal Court House & Office Bldg | Sacramento, Calif | L A O'Meara | F B Gardner & E C Braun | New | 1961 | 1100 | 320 | Cen | YO | OB |
| 17 | Bank For Savings Bldg | Birmingham, Ala | Jaros Baum & Bolles | S A Brown Co | New | 1962 | 1000 | 250 | Cen,Plkg,HP | CC | OB |
| 18 | Traders National Bank Bldg | Kansas City, Mo | Leo L Landauer & Assoc | Natkin & Co | New | 1962 | 956 | 251 | Cen | CC | OB |
| 19 | Bloomingdale's Dept Store | New York, N Y | Jaros Baum & Bolles | H Sand & Co Inc | Ex | 1961 | 955 | 200 | Cen,Ab | CC | Dpt |
| 20 | The Torrington Co | Clinton, S C | ..... | Daniel Const Co | New | 1961 | 800 | 49 | Cen | CC | IP |
| 21 | Rochester Gas & Electric Co | Rochester, N Y | R E Cherne & G D Dickason | L J Roth Co & Denise Plbg Inc | Ex | 1961 | 760 | 115 | Cen,Ab | YO | OB |
| 22 | Community Research & Development | Charlottetown, N C | Mechanical Engrs, Inc | Hicks & Ingle Co | New | ..... | 750[19] | 200 | Plkg,Cen,CO,Ab | CC | Cmr |
| 23 | American Can Co, Dixie Cup Div | Fort Smith, Ark | ..... | Benco, Inc | ..... | 1961 | 750 | ..... | Cen,CO | CC | IP |
| 24 | UCLA - Engrg Unit 3 | Westwood, Calif | Levine & McCann | Western Air & Refrigeration[20] | New | 1961 | 750 | 225 | Cen,Com,Ab | YO | Ins |
| 25 | 1441 Kapiolan Bldg | Honolulu, Hawaii | John Graham & Co | Sam P Wallace of the Pacific Ltd | New | 1961 | 700 | ..... | Cen,CO | TR | OB |
| 26 | U of Illinois, Physics Bldg | Urbana, Ill | Shaw Metz & Dolio | F R Inskip & Co | New | 1961 | 680 | 48 | Cen,Ab | CC | Ins |
| 27 | Monrobot, Bldg No 31 | Woodland Hills, Calif | Budlong & Assoc | Kilpatrick & Co | New | 1961 | 650 | 150 | Cen | CC | IP |
| 28 | Floyd County Hospital | New Albany, Ind | Southern Engrg Co | V J Knaebel Plbg & Htg Co | New | 1962 | 620 | ..... | Cen,Ab | CC | Hosp |
| 29 | U of Missouri, Library | Columbia, Mo | John D Falvey | Natkin & Co | New | 1961 | 610 | ..... | Cen,Ab | CC | Ins |
| 30 | Owens-Illinois Bldg | Toledo, O | Skidmore, Owings & Merrill | Spitzley Corp | Ex | 1960 | 610 | 180 | Cen | CC | OB |
| 31 | Birmingham News | Birmingham, Ala | James A Evans | Shook & Fletcher Supply Co | Ex | 1961 | 600 | 175 | Cen | CC | IP |
| 32 | Armco Steel Corp, Research Bldg | Middletown, O | Kramer, Comer & Passe | Limbach Co | New,Ex | 1961 | 600 | ..... | Cen,HP | TR | Lab |
| 33 | Rancho Los Amigos Hospital | Downey, Calif | M A Nishikian | J Herman Co Inc | New | 1961 | 600 | 88 | Cen,Ab | CC | Hosp |
| 34 | Burlington Industries, Inc | Mooresville, N C | Self | The Bahnson Co | ..... | 1961 | 600 | 61.6 | Cen | CC,BAN | IP |
| 35 | Am Building | Beaumont, Texas | Wm K Hall & Assoc | Natkin & Co | New | 1961 | 550 | 220 | Cen | CC | OB |
| 36 | Habersham Mills | Habersham, Ga | Robert & Co, Assoc | The Bahnson Co | Ex | 1961 | 520 | 50 | Cen | BAN,CC | IP |
| 37 | Gen Adm Project "A" Bldg | Olympia, Wash | Harmon Pray & Detrich | Capital Plbg & Htg Co Inc | New | 1961 | 520 | 163 | Cen,Ab | CC | OB |
| 38 | Elk Cotton Mills | Fayetteville, Tenn | I C Thomasson | The Bahnson Co | Ex | ..... | 519 | 55.8 | Cen | BAN | IP |
| 39 | Federal Building | Albuquerque, N M | Bridgers & Paxton | Bonded Plbg & Htg | New | ..... | 500 | 200 | Cen | AB | OB |
| 40 | Graniteville Co | Augusta, Ga | ..... | The Bahnson Co | ..... | ..... | 483 | 36.7 | Cen | BAN | IP |
| 41 | Nissen Building | Winston-Salem, N C | J N Pease & Co | Air Conditioning Corp | New | 1961 | 475 | 131.5 | Cen | CC | OB |
| 42 | Cache Road Square | Lawton, Okla | Edward B Koch | Koch Engineering | New | 1961 | 450 | 157 | Cen,Ab | ..... | Cmr |
| 43 | Kansas U, Wahl Hall | Kansas City, Kan | Scott & Kinney | Keener Air Inc | New | 1962 | 450 | 90 | Cen[28] | CC | Ins |
| 44 | Riegel Textile Corp | Ware Shoals, S C | ..... | The Bahnson Co | ..... | ..... | 450 | 49.5 | Cen | CC,BAN | IP |
| 45 | National Rejectors, Inc | Hot Springs, Ark | Sverdrup & Parcel | Pickens-Bond Construction Co | New | 5-61 | 437.5 | 117 | Plkg | WE | IP |
| 46 | U S AEC, Plasma Physics Lab | Princeton, N J | Commonwealth Assoc Inc | Turner Const Co[29] | New | ..... | 430 | 63.6 | Cen | YO | Lab |
| 47 | Weinstock-Lubin Dept Store | Sacramento, Calif | Ayres & Hayakawa | F B Gardner | New | 1961 | 420 | 130 | Cen,CO | YO | Dpt |
| 48 | Diamond Alkali | Painesville, Ohio | Giffels & Rossetti | The Smith & Oby Co | New | 1961 | 415 | 23.7 | Cen,Ab | CC | Lab |
| 49 | Linde Medical Plaza | Los Angeles, Calif | Levine & McCann | Western Air & Refrigeration, Inc | New | 12-61 | 408 | 120 | Cen | CC | OB |
| 50 | Hillcrest Hospital | Waco, Texas | Wm K Hall & Assoc | Jacobs-Cathey Co | New | 1962 | 400 | ..... | Cen,Ab | CC | Hosp |
| 51 | Southern Calif Edison Co | Long Beach, Calif | Hugh Carter Engrg Co | F B Gardner[31] | New | 1961 | 400 | 100 | Cen,HP | YO | OB |
| 52 | Guardian Life Insurance Co | Annex, N Y | Syska & Hennessy, Inc | Mance Corp | New | 1961 | 400 | 120 | Cen,Ab | CC | OB |
| 53 | U S Court House & Post Office | Birmingham, Ala | James A Evans | Wood-Leppert Co | Ex | 1961 | 400 | 115 | Cen | TR | OB |
| 54 | General Electric Corp | Syracuse, N Y | ..... | C W Davis Supply Co Inc | Ex | 1960 | 385 | 75 | Cen | YO | IP |
| 55 | Spindale Mills | Spindale, N C | P L Davidson | Buensod-Stacey Corp | Ex | 1959 | 365 | ..... | Cen | CC | IP |
| 56 | ILGWU Building | New York, N Y | DiGiacomo & Caretsky Assoc | Raisler Corp | New | ..... | 360 | 136 | Cen,Ab | CC | OB |
| 57 | Gibraltar Savings & Loan Assoc | Beverly Hills, Calif | Victor Gruen Arch | A & S Air Conditioning | New | 1961 | 350 | 90 | Cen | YO | OB |

MANUFACTURERS

- AAF - American Air Filter Co Inc
- AB - American Blower, Div of American Standard
- AC - Allis-Chalmers Mfg Co
- AE - Acme Engrg & Mfg Corp
- AL - Aladdin Industries, Inc
- AM - Air-Maze Corp
- AR - Armstrong Cork Co
- BAC - Baltimore Aircoil Co, Inc
- BAN - Bahnson Co
- BC - Barber Coleman Co, Controls Div
- BF - Buffalo Forge Co
- BR - Browning Mfg Co
- BU - Burke & Co
- BY - Belcher-Young Inc
- CC - Carrier Corp
- CCF - Cooling Corp of Florida
- CE - Century Electric Co
- CFC - Cambridge Filter Corp
- CHB - Chicago Blower Corp
- CL - Clarage Fan Co
- CON - Continental Air Filters, Inc
- DE - Dryer Electric
- DH - Drayer Hanson Div
- DO - Dodge Mfg Corp
- DOL - Dollinger Corp
- EA - Electro-Air Cleaner Co, Inc
- ED - Electro-Dynamic Div of General Dynamics Corp
- EKC - E K Campbell Co
- EL - Elliott Co
- EM - Electric Machinery Mfg Co
- FA - Farr Co
- FG - Fibre Glass Div, Ferro Corp
- FM - Fairbanks, Morse & Co
- FP - Fluor Products Co
- FQ - Fedders-Quigan Corp
- FR - Fram Corp
- FW - Foster Wheeler Corp
- GA - Gallaher Co
- GB - Gustin-Bacon Mfg Co
- GE - General Electric Co
- GF - E D Goodfellow & Co
- HC - Havens Cooling Towers Div
- HE - Howell Electric Co
- IA - Industrial Acoustics Inc
- IE - Ideal Electric & Mfg Co
- JM - Johns-Manville
- JS - Johnson Service Co
- K - Korfund Co, Inc
- KE - Kennard Div
- LA - Louis Allis Co
- LC - Lamson Corp, Billmyre Blower Div
- LH - Lillie-Hoffman Cooling Towers Inc
- MC - Marley Co
- MCC - Mario Coil Co
- McQ - McQuay, Inc
- MH - Minneapolis-Honeywell Regulator Co
- MI - Mason Industries
- MIW - Murray Iron Works Co
- MWP - Marshall, Neal & Pauley
- NYB - New York Blower Co
- OC - Owens-Corning Fiberglas Corp
- P - J F Pritchard & Co
- PCM - Philip Carey Mfg Co
- PCT - Phillips Cooling Tower Co
- PE - Peerless Electric Co
- RC - Recold Corp
- RE - Reliance Electric & Engrg Co
- SW - Sturtevant Div, Westinghouse Electric Corp
- SWT - Swartwout Co
- THE - Thermal Engrg Corp
- TR - Trane Co
- TRI - Trion, Inc
- TST - Terry Steam Turbine Co
- UA - United Air Conditioning Corp
- VE - Vibration Eliminator Co

# Air-conditioning systems

## Table 1 continued

| Project Number | REFRIGERATION EQUIPMENT | | | | | | | | | | | COOLING TOWERS | | | | | | | | AIR CLEANERS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. new units | Compressor type | Rpm | Refrigerant | Compressor drive | Drive hp | Drive manufacturer | H2O to coils, F | H2O from coils, F | Cooling medium | Condenser type | No. of towers | Manufacturer | Capacity, gpm | Cooling range, F | Wet bulb temp, F | Fill | Coating | Cooling water treatment | No. of cleaners | Manufacturer | Type | Ductwork type |
| 1 | 4 | Ce,Mu | 4400 | R-11,R-12 | T | .....[4] | EL | 36 | ..... | CW | ..... | 3 | FP | ..... | 112-84 | 78 | Rdw,Pl | ..... | ..... | 40 | AAF | Fl | HV,Cc,DD |
| 2 | 5 | Ce | 7000 | ..... | T | 1000[5] | WO | 45/57 | 55/67 | CW | WC | 7 | MB | 15,000 | 105-85 | 78 | .....[6] | ..... | SC | 200 | ..... | Fl | Rec,Cc[7,8] |
| 3 | 4[11] | Ce | 3600 | F-11,F-12 | M | .....[12] | ..... | 42 | 60 | CW | WC,Air | 2 | MC | 13,000[5] | 98-85 | 78 | Rdw | ..... | CSA | 31 | AAF,CON | Fl,DC | Rec, SD[7] |
| 4 | 3 | Ce | ..... | F-11 | M | 900 | GE | 42 | 52 | CW | WC | 4 | PCT | 11,500 | 95-85 | 78 | Rdw | ..... | CSA | 573 | AAF | Fl | Rec, DD, HV |
| 5 | 3 | Ce | 7180 | F-12 | M | 800 | EM | 46 | 58 | CW | WC | 1 | MC | 7,200 | 95-85 | 75 | Rdw | G | SC | 19 | FA | Fl | Rec, SD, LV |
| 6 | 2 | Ce | 3450 | R-11 | T | 225[013] | EL | 42 | 54 | CW | WC | 1 | PCT | 6,750 | 107-86 | 78 | Rdw | ..... | CSA | 16 | CON | Fl | Rec,Cc[7] |
| 7 | 16 | Ce,Rp | ..... | R-22 | .... | ..... | ..... | .... | ..... | CW,DER | WC | 1 | ..... | ..... | ..... | ... | ..... | ..... | ..... | ... | ..... | Fl | Rec, Cc, HV, SD |
| 8 | 2 | Ce | ..... | F-12 | T | 2280 | MW | 42 | 52 | CW | WC | 5 | MC | 6,450 | 108-88 | 78 | Rdw | G | SC | 400 | FA | Fl | SD, Rec, Cc[7] |
| 9 | .... | ..... | ..... | ..... | .... | ..... | ..... | 48 | 60 | CW | ..... | 1 | MC | 5,235 | 103.7-85 | 78 | Rdw | ..... | ..... | ... | ..... | ..... | SD |
| 10 | .... | ..... | ..... | ..... | .... | ..... | ..... | .... | ..... | CW | ..... | 1 | MC | 5,400 | ..... | ... | Rdw | AsTr | CSA | Sev | CFC | Fl | Rec |
| 11 | 1 | Ce | 4900 | R-11 | T | 602 | EL | 43 | 53 | CW[15] | WC | 1 | FP | 4,210 | 102-85 | 78 | Rdw | AsC | CSA | 14 | AAF | Fl,Pr | Rec, SD, LV |
| 12 | 1 | Ce | 3600 | F-11 | M | 1400 | CC | 42 | 52.4 | CW | WC | 1 | MC | 3,850 | 97-87 | 78 | Rdw | ..... | SC | 9 | GC | Wa | Rec, LV, SD |
| 13 | 1 | Ce | 6400 | R-114 | T | 462 | TST | 43 | 53 | CW[15] | WC | 1 | MC | 3,600 | 101-85 | 78 | Rdw | AsC | CSA | 12 | CON | Fl,Pr | Rec, SD, LV |
| 14 | 2 | Ce | ..... | F-11 | M | ..... | TR | 52 | 58 | CW | WC | 1 | MC | 4,350 | 93-85 | 79 | Rdw | ..... | CSA | ... | ..... | Fl | Rec, SD, LV |
| 15 | 2 | Ce,SS | ..... | R-114 | M | 500 | ..... | 43 | 55 | CW | WC | 1 | P | 3,300 | 90-80 | 67 | Rdw | ..... | CSA | 5 | EA | Fl,Pr | Rec, Cc, HV, DD |
| 16 | 2 | Ce,SS | ..... | R-114 | M | 550 | ..... | 46 | ..... | CW | WC | 1 | MC | 3,200 | 95-85 | 75 | Rdw | AsC | ..... | ... | ..... | ..... | Rec,Cc[7,8] |
| 17 | 1 | Ce,Rp | 3600 | F-11 | M | 1000 | EL | 42 | 52/54 | CW | WC | 2 | ..... | 3,200[13] | 95-86 | 78 | Rdw | ..... | CSA | 7 | ..... | Pr | Rec,Cc[7,8] |
| 18 | 2 | Ce,Rp | .....[17] | .....[17] | M | ..... | ..... | 40 | 48 | CW | WC | 2 | MC | 108[18] | 95-85 | 78 | Rdw | ..... | ..... | ... | ..... | ..... | Rec,Cc,SD[7] |
| 19 | .... | ..... | ..... | ..... | .... | ..... | ..... | 42 | 58 | CW | ..... | 1 | PCT | 6,700 | 102-85 | 78 | Rdw | ..... | SC | 2 | AAF | Fl | Rec, SD[7] |
| 20 | 2 | Ce | 3540 | R-11,R-113 | T | ..... | ..... | 40 | 52 | CW | WC | 1 | MC | 2,400 | 95-85 | 78 | Rdw | ..... | CSA | 4 | MH,AAF | Wa,Fl,DC | Rec, SD, LV |
| 21 | .... | ..... | ..... | ..... | .... | ..... | ..... | 42 | 52 | CW | WC | 3 | MC | 1,050 | 103-85 | 78 | Rdw | AsC | CSA | 3 | DOL | Fl,Pr | HV, DD, LV |
| 22 | 5 | Rp | ..... | F-12,F-22 | M | ..... | ..... | 42 | 48 | CW | WC,Air | 1 | CC | 1,400 | 100-85 | 78 | ..... | ..... | SC | 2 | AAF | Fl | Rec, SD, LV |
| 23 | 1 | Ce | 1750 | ..... | .... | ..... | ..... | .... | ..... | CW | WC | 1 | MC | ..... | 95-85 | 78 | Rdw | ..... | ..... | N | ..... | ..... | Cc, HV |
| 24 | 1 | Ce | 10000 | R-11 | T | 260 | GE | 45 | 57 | CW | WC | 3 | FP | 845[5] | 100-85 | 72 | Rdw | ..... | CSA | 15 | BU | Fl | Rec, LV, DD |
| 25 | 2 | Ce | 3600 | R-11 | M | 325 | LA | 43 | 50 | CW | WC | 2 | MC | 2,055 | 95-85 | 78 | Rdw | ..... | ..... | ... | ..... | Fl,Pr | DD[7] |
| 26 | .... | ..... | ..... | ..... | .... | ..... | ..... | 40 | 50 | ..... | ..... | 1 | MC | 1,460 | 100-85 | 78 | Rdw | ..... | ..... | Ex | ..... | ..... | Rec[7,8] |
| 27 | 2 | Ce | 3600 | R-113 | M | ..... | ..... | 42 | 60 | CW | WC | 1 | FP | 2,000 | 95-85 | 72 | Pl | ..... | ..... | 160 | FA | Fl | Rec, SD, LV |
| 28 | .... | ..... | ..... | ..... | .... | ..... | ..... | 42 | 52 | CW | WC | 1 | MC | 2,400 | 103-85 | 78 | Rdw | ..... | CSA | 2 | AAF | Wa,Fl,Pr | Rec,Cc[7,8] |
| 29 | .... | ..... | ..... | ..... | .... | ..... | ..... | 45 | 53 | CW | WC | 1 | MC | 2,200 | 102-85 | 78 | Rdw | ..... | SC | 26 | ..... | Fl | SD |
| 30 | 2 | Ce | 3550 | R-113 | M | 300 | CC | 45 | 57 | CW | WC | 2 | CC | 915[5] | 95-85 | 75 | ..... | .....[21] | CSA | 2 | AAF | Fl | Rec,Cc[7] |
| 31 | 1 | Ce | 3600 | F-11 | M | 600 | EL | 42 | Var | CW | WC | 1 | MC | 1,800 | 95-86 | 78 | Rdw | ..... | CSA | 26 | AAF,CC[22] | Wa,Pr | Rec, SD |
| 32 | 1 | Ce | 3600 | F-11 | M | 380 | TR | 45 | 55 | CW,Well | ..... | Well | ..... | ..... | ..... | ... | ..... | ..... | ..... | 1 | TRI | Pr | Cc,DD[7] |
| 33 | .... | ..... | ..... | ..... | .... | ..... | ..... | 45 | 55 | CW | ..... | 1 | FW | 2,020 | 99.6-81.5 | 72 | Rdw | ..... | SC | ... | FA | Fl | Rec, LV |
| 34 | 1 | Ce | 3600 | F-11 | M | ..... | ..... | .... | ..... | CW | WC | 1 | MC | 1,350 | 95-85 | 78 | .....[23] | ..... | CSA | N | ..... | ..... | Rec |
| 35 | 2 | Ce,Rp | .....[24] | .....[24] | M | ..... | ..... | 44 | 52 | CW | WC | 1 | MC | ..... | 96-86 | 80 | Rdw | ..... | N | ... | ..... | ..... | Rec, SD, LV |
| 36 | 1 | Ce | 3600 | F-11 | M | ..... | ..... | .... | ..... | ..... | WC | 1 | MC | ..... | ..... | ... | ..... | ..... | ..... | 3 | AAF | Fl | Rec |
| 37 | .... | ..... | ..... | ..... | .... | ..... | ..... | 42 | 52 | CW | ..... | 1 | MC | 2,050 | 95-80 | 65 | Rdw | ..... | CSA | 180 | AAF | Fl | 7,8 |
| 38 | 1 | Ce | 3600 | F-11 | M | ..... | ..... | 44 | 54 | CW | WC | 1 | MC | 1,560 | 95-85 | 78 | .....[25] | ..... | ..... | 17 | BAN | Fl | .....[26] |
| 39 | 2 | Ce | 3600 | F-11 | M | 250[5] | AB | 45 | 53 | CW | WC | 1 | MC | 1,500 | 95-85 | 70 | Rdw | ..... | CSA | 16 | AAF | Fl | Rec |
| 40 | 1 | Ce | 3600 | F-11 | M | ..... | ..... | .... | ..... | ..... | WC | 1 | MC | ..... | ..... | ... | ..... | ..... | ..... | 4 | BAN | Fl | Rec |
| 41 | 1 | Ce | 3600 | F-11 | M | 500 | IE | 45 | 55 | CW | WC | 1 | CC | 1,450 | 95-85 | 78 | Pl | ..... | SC | ...[27] | AAF | Fl | Rec, SD, LV |
| 42 | .... | ..... | ..... | ..... | .... | ..... | ..... | 44 | 54 | CW | ..... | 1 | MC | 1,760 | 103-85 | 77 | Rdw | ..... | CSA | 33 | Var | Fl | Rec, SD, LV |
| 43 | 1 | Ce | 3600 | R-112 | M | 450 | ..... | 45 | 53 | CW | WC | 1 | MC | 1,350 | 95-85 | 78 | Rdw | ..... | CSA | N | ..... | ..... | Rec, LV |
| 44 | 1 | Ce | 3600 | F-11 | M | 425 | ..... | .... | ..... | CW | WC | 1 | MC | 1,350 | 95-85 | 78 | .....[25] | ..... | ..... | ... | ..... | ..... | Rec |
| 45 | 45 | Rp,SS | ..... | F-22 | M | 10 | WE | .... | ..... | DER | Air | N | ..... | ..... | ..... | ... | ..... | ..... | ..... | N | ..... | ..... | Rec, LV |
| 46 | 2 | Ce,SS | 10200 | F-11 | M | 250 | AC | 40 | 52 | CW | WC | 1 | FP | 2,700 | 99-85 | 78 | Rdw | ..... | CSA | 7 | WE,TRI | Fl,Pr | Rec, SD, LV |
| 47 | 2 | Ce,SS | ..... | R-11 | M | 220 | ..... | 45 | 57 | CW | WC | 1 | FP | 1,220 | 95-85 | 72 | Rdw | ..... | ..... | ... | FA | Fl | Rec,Cc[16] |
| 48 | .... | ..... | ..... | ..... | .... | ..... | ..... | 48 | ..... | CW | WC | 1 | P | 1,370 | 105-85 | 75 | Rdw | ..... | CSA | 2 | AAF | Fl | Rec |
| 49 | 2 | Ce | ..... | ..... | M | 400[13] | CC | 44 | 56 | CW | WC | 1 | MC | 1,240 | 95-85 | 70 | Rdw | ..... | ..... | ... | BU | Fl | HV, DD |
| 50 | .... | ..... | ..... | ..... | .... | ..... | ..... | 42 | 51 | CW | WC | 1 | FP | 1,470 | 101-85 | 78 | Rdw | Pl | ..... | 202 | AAF,EA | Wa,Fl,Pr[30] | Rec, LV |
| 51 | 4 | Rp | 1750 | R-12 | .... | 125[5] | WEC | 42 | 52 | CW | WC | ...[32] | ..... | ..... | ..... | ... | ..... | ..... | ..... | ... | MH | Pr | HV |
| 52 | .... | ..... | ..... | ..... | .... | ..... | ..... | 47 | 57 | CW | ..... | 1 | PCT | 1,430 | 99-85 | 78 | Rdw | ..... | SC | 120 | AAF | Fl | Rec, SD, LV |
| 53 | 2 | Ce | 3600 | F-114 | M | 200[5] | LA | 45 | Var | CW | WC | 1 | LH | 1,200 | 95-87 | 78 | Rdw | ..... | CSA | 15 | CON | Fl | Rec, SD, LV |
| 54 | 1 | Ce | 7000 | R-11 | M | 300 | ..... | .... | ..... | CW | WC | 1 | MC | 1,200 | ..... | 78 | Rdw | ..... | ..... | ... | ..... | Fl | Rec, SD, LV |
| 55 | 1 | Ce | ..... | ..... | .... | ..... | ..... | .... | ..... | CW | WC | 1 | BY | 1,080 | 95-85 | 78 | Rdw | ..... | ..... | ... | ..... | ..... | Rec |
| 56 | .... | ..... | ..... | ..... | .... | ..... | ..... | .... | ..... | CW | WC | 1 | BAC | 1,350 | 103-82 | 78 | Me | ..... | SC | ... | AAF | Fl | Rec, SD, LV |
| 57 | 1 | Ce | 3500 | R-11 | M | ..... | ..... | 40 | 52 | CW | WC | 1 | FP | 1,050 | 95-85 | 72 | Rdw | ..... | CSA | 2 | BU | Fl | Rec,Cc[7,8] |

VM - Vibration Mountings, Inc
WE - Westinghouse Electric Corp
WEC - Wagner Electric Corp
WO - Worthington Corp
YO - York Div, Borg-Warner Corp

SYMBOLS USED ABOVE

Ab - Absorption
Add - Addition
Air - Air cooled
Al - Aluminum foil
Apt - Apartment
As - Asbestos
AsC - Asbestos-cement
Bl - Blanket
Bo - Board
Cc - Circular conduit
Ce - Centrifugal
Cen - Central
Cer - Ceramic
Ck - Cork
Cmr - Commercial center
CO - Cooling only
Com - Compression
CS - Central scanning
CSA - Chemicals self administered
CW - Chilled water
DC - Dust collector
DD - Dual duct
DER - Direct expansion refrigerant
Dej - Done on the job
Dpt - Department store
E - Electric
El - Electronic
Ex - Existing plant or equipment
F - Freon
Fg - Fiber glass
Fl - Filter
Foam - Foam glass
FSA - Fabricated sound absorbers
G - Galvanized
H - Humidity
Ho - Hotel
Hosp - Hospital
HV - High velocity
ID - Inside duct
Imp - Impregnated paper
IMR - Inside machinery room
Ins - Institution
IP - Industrial Plant
Lab - Laboratory, Research bldg
LV - Low velocity
M - Motor
MC - Mastic coating
Me - Metal
Mu - Multi-stage
N - None
Ne - Near equipment
NG - At or near grill
OB - Office building
Pl - Plastic
Pn - Pneumatic
Pr - Precipitator
Pre - Presealed
R - Refrigerant
Rdw - Redwood
Rec - Rectangular duct
Ris - Rubber-in-shear
Rp - Reciprocating
SC - Service contract
SD - Single duct
Sev - Several
Sp - Springs
SS - Single stage
St - Steel
T - Turbine drive
Tp - Temperature
Tr - Transite
Var - Various, varies

| AIR HANDLING EQUIPMENT | | | | | | | | | | | | | | | | | CONTROLS | | | VIBRATION MOUNTS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SUPPLY FANS | | | | | | | RETURN FANS | | | | | | | INSULATION | | | | | | | | | |
| Number | Capacity 1000 cfm | Rpm | Manufacturer | Drive hp | Drive rpm | Drive manufacturer | Number | Capacity 1000 cfm | Rpm | Manufacturer | Drive hp | Drive rpm | Drive manufacturer | Type | Manufacturer | Vapor seal | Manufacturer | Type | Location | Manufacturer | Type | Sound absorbent | Insert Number |
| 26 | Var | Var | BF | 500 | Var | CE | 9 | Var | Var | BF | Var | Var | CE | Fg,Bl | ..... | Al | MH | Tp,H,Pn,E | NG | ..... | Sp | FSA | 1 |
| 100 | ..... | ..... | CC | ..... | ..... | ..... | 75 | ..... | ..... | CC | ..... | ..... | ..... | Fg | OC | Al | JS | Tp,H,Pn | NG,CS | VE | Sp,Ris,Ck | ID,FSA | 2 |
| 31 | 477.8[13] | Var | .....[33] | 266[13] | 1800 | Var | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | .....[34] | MC,Al,Imp | .....[35] | Tp,H,Pn | NG | ..... | Sp,Ris,Ck | ID | 3 |
| 23 | 662 | ..... | AB,BF | ..... | ..... | ED | 34 | 662 | ..... | AB,BF | ..... | ..... | ED | Fg | ..... | ..... | ..... | Tp,El | NG,CS | K | Sp,Ris | FSA | 4 |
| 19 | 985[13] | 400-500 | PE | 602[13] | 1750 | RE | 1 | 114.3 | 260 | PE | 30[13] | 1750 | RE | Fg | JM | Imp | JS | Tp,Pn | NG,CS | VM | Sp,Ris | N | 5 |
| 16 | 460 | Var | AB | 445 | 1750 | AC | 11 | 330 | Var | AB | 195 | 1750 | AC | Fg | JM | Pre | MH | Tp,H,Pn | CS | VM | Ris | ID | 6 |
| 23 | 0.15-58 | ..... | WE | ..... | ..... | ..... | 25 | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Doj | ..... | Tp,H,Pn,E | NG,CS | ..... | Ris,Ck | ID,FSA | 7 |
| 14 | 500 | Var | WE | Var | Var | WE | 20 | ..... | ..... | ..... | ..... | ..... | ..... | Fg | OC | Doj,Al,Imp | MH | Tp,H,Pn | ..... | VE | Sp,Ris | .....[38] | 8 |
| 6[37] | 70 | ..... | TR | ..... | 1750 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Pre | ..... | Pn | ..... | ..... | ..... | ID | 9 |
| 25 | ..... | Var | AB | 15-25 | Var | GE | N | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | MH | Tp,H,Pn,E | CS | ..... | ..... | ID | 10 |
| 14 | 451.3[13] | .....[38] | YO,TR | 340[13] | 1750 | HE | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg,Bo | OC | Al,Pre,Doj | MH | Tp,H,Pn,El | CS | YO | Ris | N | 11 |
| 9 | 412 | Var | CC | 390[13] | ..... | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Foam | ..... | MC,Doj | JS | Tp,H,Pn | NG | ..... | Ris,Ck | ..... | 12 |
| 13 | 323.8[13] | .....[39] | TR | 335[13] | 1760 | LA | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg,Bo | OC | Al,Pre,Doj | MH | Tp,Pn,El | CS | TR | Ris | N | 13 |
| ..... | ..... | ..... | BF | ..... | ..... | ..... | ..... | ..... | ..... | BF | ..... | ..... | ..... | Fg,Var | JM | Al,Doj,Pre | MH | H,Pn,El | CS | MNP | Sp,Ris,Ck | FSA,ID | 14 |
| 19 | 180 | ..... | AB | 270 | ..... | ..... | 24 | 160 | ..... | AB | 150 | ..... | ..... | Fg | ..... | Imp | JS | Tp,H,Pn | NG,CS | ..... | Sp,Ris | ID,IMR | 15 |
| ..... | ..... | .....[40] | TR | 325[13] | .....[41] | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | ..... | MH | Tp,H,Pn,El | ..... | ..... | Sp,Ris | .....[36] | 16 |
| 7 | 240 | ..... | AB,CC | 394 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Pre,MC,VP | JS | Tp,Pn,El | NG,CS | ..... | Sp,Ris,Ck | ..... | 17 |
| 9 | 323.3 | ..... | BF | 200 | 422 | WE | 2 | 261 | 262 | BF | 60 | 1750 | WE | ..... | JM | ..... | PR | Tp,Pn | CS | ..... | Sp,Ris | FSA | 18 |
| 2 | 300 | 422 | BF | 30-50 | 1750 | AC | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Pre | JS | Tp,Pn | CS | MI | Sp | ID | 19 |
| 4 | 200 | ..... | BF | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Doj | MH | Tp,H,Pn,El | NG,CS | ..... | Ris | ID | 20 |
| 3 | .....[42] | ..... | CL | .....[43] | ..... | AC | 3 | .....[44] | ..... | CL | .....[45] | ..... | AC | ..... | ..... | ..... | JS | Tp,H,Pn | CS | ..... | Sp | IMR,FSA | 21 |
| 1 | 65 | ..... | CC | 40 | 1750 | EL | 1 | 50 | ..... | CC | 15 | 1750 | EL | Fg | JM | MC | BC | Tp,H,El | ..... | K | Sp,Ris | ID | 22 |
| 4 | ..... | ..... | CC | 50 | ..... | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Pre | PR | Pn | CS | CC | Ris | N | 23 |
| 15 | 270 | Var | AL | 182[13] | 1750 | BR | 13 | 180[13] | Var | AL | 40[13] | 1750 | BR | Fg | OC | N | PR | Tp,Pn | NG,CS | ..... | Ris | ID | 24 |
| 3 | ..... | ..... | WE | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Doj | JS | Pn | CS | K | Sp | ID | 25 |
| 11 | 61 | ..... | ..... | 25[5] | 1750 | ..... | 4 | 51 | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Doj | MH | Tp,H,Pn | ..... | ..... | Ris | ID | 26 |
| 20 | 250[13] | ..... | CC | 15 | ..... | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | JM | ..... | MH | Tp,H,Pn,E | ..... | ..... | Ris | N | 27 |
| 5 | .....[46] | ..... | AB | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | OC | .....[47] | MH | Tp,H,Pn | NG,CS | K | Ris | ID,FSA | 28 |
| 26 | 255.4 | .....[48] | ..... | 3-10 | ..... | ..... | 26 | 255.4 | .....[49] | CC | 3-10 | ..... | ..... | Fg,Bl | ..... | Doj | JS | Pn | NG,CS | ..... | ..... | ID | 29 |
| 14 | 145 | ..... | CC | 170 | 1800 | DO,AC | 6 | 97.3 | ..... | CC | 40 | 1800 | DO,AC | Fg | OC | Al | JS | Tp,H,Pn | CS | VE | Sp,Ris | ID,FSA | 30 |
| 24 | 200 | ..... | CC | 100 | ..... | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | ..... | ..... | Tp,Pn | ..... | ..... | Ris,Ck | ID,FSA | 31 |
| 1 | 80 | ..... | TR | 150 | ..... | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Pre,Al | MH | Tp,H,Pn,E | CS | ..... | Sp,Ris | ID | 32 |
| 23 | 5[50,5] | ..... | McQ | 3[50,5] | ..... | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | ..... | JS | Tp,Pn | CS | ..... | Sp | ID,FSA | 33 |
| 6 | .....[51] | 1150 | CC | .....[51] | ..... | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Foam,Ck | ..... | Pre,MC,Doj | JS | Tp,H,Pn | NG,CS | ..... | ..... | ..... | 34 |
| 13 | ..... | ..... | CC | 7.5 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | GB | Al,Doj | ..... | Tp,Pn | ..... | ..... | Ris | ID | 35 |
| 4 | 208[13] | ..... | BF | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | JS | Tp,H,Pn | NG,CS | ..... | ..... | ..... | 36 |
| 2 | 110 | 824 | CHB | 200 | 1200 | ..... | 1 | 166 | 470 | CHB | 125 | 1750 | ..... | Fg | OC | VP | JS | Tp,Pn | NG | VM | Sp | ID,FSA | 37 |
| 17 | 9-13.8 | ..... | BAN | 5-7.5 | 1750 | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Foam | ..... | MC,Pre | MH | Tp,H,E,El | NG,CS | ..... | ..... | ..... | 38 |
| 16 | 20 | ..... | AB | 10 | ..... | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | OC | Pre | MH | Tp,Pn | ..... | K | Sp | ID | 39 |
| 6 | 153.6 | ..... | BAN | 80 | ..... | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Foam | ..... | MC,Pre | JS,BAN | Tp,H,Pn | NG,CS | ..... | ..... | ..... | 40 |
| 17 | 8.1-14.0 | 850 | CC | 5-7.5,10 | 1750 | GE | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg,Bl,Bo | OC | Al,Pre | JS | Tp,Pn | CS | VM | Sp | IMR | 41 |
| 33 | 0.8-24 | ..... | TR,UA | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg,Bl | OC | Pre,Al,Imp | MH | Tp,Pn,El | ..... | ..... | Sp,Ris | ..... | 42 |
| 8 | 91.7[13] | ..... | AB | 81[13] | .....[52] | ..... | 3 | 17.1[13] | ..... | AB | 4.5[13] | 1750 | ..... | Fg | JM | Doj | JS | Pn | ..... | K | Sp | ..... | 43 |
| 4 | 40[5] | .....[53] | BAN | 25 | 1750 | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Foam,Ck | ..... | MC,Pre | JS | Tp,H,Pn | NG,CS | ..... | ..... | ..... | 44 |
| 52 | 4-50.1 | ..... | WE | 2-15 | .....[54] | WE | 8 | 9.5-36.1 | .....[54] | SWT | .5-7.5 | .....[55] | ..... | Fg | ..... | Doj | ..... | Tp,E | NG | WE | Sp | N | 45 |
| 1[56] | 97.4 | 431 | TR | 50 | 1750 | CE | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg[57] | ..... | Imp | MH | Tp,H,Pn,E | CS | VE | Sp,Ris | ID | 46 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Al | BC | Tp,El | NG,CS | ..... | Ris | FSA | 47 |
| 5 | 106.7[13] | ..... | WE,AB | 63[13] | ..... | GE | 3 | 26[13] | ..... | WE | 7.25 | ..... | GE | Fg | ..... | Pre | MH | Tp,Pn | CS | K | Sp,Ris | ..... | 48 |
| 2 | 68.5 | 985 | WE | 100[5] | 1800 | WO | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | ..... | PR | Tp,Pn | ..... | ..... | Sp | ID,FSA | 49 |
| 152 | Var | ..... | CC | Var | ..... | CC | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg,Bo | ..... | Pre,Doj | MH | Tp,H | NG,CS | K | Sp,Ris | ID,FSA | 50 |
| 2 | 72[5] | ..... | ..... | 100[5] | ..... | ..... | 2 | ..... | ..... | ..... | 25 | ..... | ..... | Fg | ..... | Al | MH | Tp,Pn | NG | ..... | Sp | ID,FSA | 51 |
| 5 | 120 | Var | TR | 140 | Var | ..... | 4 | 106 | Var | TR | 45 | Var | ..... | Fg | OC | Al,Pre | MH | Tp,H,Pn | No | VE | Ck,Ris | ID | 52 |
| 15 | 150 | Var | THE | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg,Bo | ..... | Al | MH | Tp,Pn,El | NG,CS | ..... | Ris | ID,FSA | 53 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Imp | MH | Tp,Pn | ..... | ..... | Sp | ..... | 54 |
| 4 | 54[5] | ..... | WE | 30 | 950 | WE | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Tp,H,Pn | ..... | ..... | ..... | ..... | 55 |
| 4 | ..... | ..... | CC | ..... | ..... | ..... | 4 | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Doj,Al,Imp | MH | Tp,H,Pn | ..... | ..... | Ris | ID,IMR | 56 |
| 2 | 35 | ..... | AB | ..... | ..... | ..... | 1 | ..... | ..... | AB | ..... | ..... | ..... | Fg | OC | Al | PR | Tp,H,Pn | ..... | ..... | Sp | ID,FSA | 57 |

VP - Vinyl plastic
Wa - Washer
WC - Water cooled
Well - Well water

1 - And W K Hall & Assoc
2 - And Sam P Wallace & Co
3 - Ultimate 19,500 tons
4 - 3 at 1000 hp; 1 at 3250 hp
5 - Bach
6 - Stainless Steel
7 - Low velocity, high velocity
8 - Single duct, dual duct
9 - Zero Gradient Synchrotron
10 - 1314.65 tons air conditioning load
11 - 2 of 1500 tons; 1 of 1000 tons; 1 of 12.65 tons
12 - 2 at 1500 hp; 1 at 1070 hp; 1 at 15 hp
13 - Total
14 - Combination system: turbine drive of centrifugal machine exhausts steam to absorption machine
15 - Solution of 20% inhibited ethylene glycol and 80% water
16 - Single duct, low velocity
17 - Centrifugal: 3550 rpm using R-11 Reciprocating: 1750 rpm using R-22
18 - And 2760 gpm
19 - Approximate; individual units in rental areas 3 to 100 tons; 230 ton absorption system in Central Mall
20 - And Leo Plumbing & Heating
21 - Fire-resistant barrier
22 - 24 American Air Filter precipitators; 2 Carrier washers
23 - Douglas fir, pressure treated
24 - Centrifugal: 1750 rpm using R-113 Reciprocating: 3500 rpm using R-22
25 - Treated fir
26 - Round, tapered (copper)
27 - Filter bank at each unit
28 - Each of 7 floors is cooled and heated from central unit on each floor
29 - And August Axrace Co
30 - 1 washer, 1 precipitator
31 - And Clarke Plumbing & Heating
32 - Air source heat pump
33 - TR, AB, WE, MCC
34 - OC, GB, JM, AR
35 - JS, MH, PR
36 - ID, IMR, FSA
37 - 1750 fan coil units
38 - 560 to 1031 rpm
39 - 928 to 1451 rpm
40 - 800 to 1250 rpm
41 - 850 to 1750 rpm
42 - 10, 30 and 100 Mcfm
43 - 7.5, 75 and 150 hp
44 - 7.4, 21 and 88 Mcfm
45 - 1.5, 5 and 25 hp
46 - 2 at 2400 cfm, 60 hp; 3 at 1000 cfm, 20 hp
47 - Pre, MC, Doj, Imp, VP
48 - 1000 to 2000 rpm
49 - 500 to 1300 rpm
50 - Average
51 - 4 at 45000 cfm, 45 hp 2 at 30000 cfm, 30 hp
52 - 2 Speed: 1750 and 1100 rpm
53 - 800 to 1800 rpm
54 - 890 to 1750 rpm
55 - 650 to 1750 rpm
56 - Plus 8 air-handling units: 52,700 cfm, by WE, 22 hp drive
57 - With ½ in. covering of mineral wool cement
58 - 3 at 11, 1 at 9 Mcfm

Table 2

# 1961 survey of commercial, industrial

Each listing covers 3 pages. Project number helps you track a specific installation after you turn facing page

| Project Number | Company | Location | Consulting Engineer | Contractor | New or existing plant | Date of initial operation | SYSTEM: Total cooling load, tons | SYSTEM: Conditioned space, area, 1000 sq ft | SYSTEM: System type | SYSTEM: Manufacturer | SYSTEM: Installed in |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 58 | Parkway Towers | Kansas City, Mo | E White | Edw W Lochman Co | New | 7-61 | 354 | ..... | Cen,Ab | CC | Apt |
| 59 | Inman Mills | Inman, S C | ..... | Buensod-Stacey Corp | New | 1960 | 350 | ..... | Cen | CC | IP |
| 60 | Newspaper Building | El Paso, Texas | N G Coleman | T N O'Kelley Plbg & Htg | Ex | 1962 | 350 | ..... | Cen,Ab | CC | IP,OB |
| 61 | Jackson Madison County Hosp | Jackson, Tenn | Daniel C Roop, PE | Air Temperature Inc | New | 1961 | 350 | ..... | Cen,CO | CC | Hosp |
| 62 | Barrow Neurological Institute | Phoenix, Ariz | Lescher & Mahoney | Johnson Brothers Inc | Ex | 1962 | 350 | 71.8 | Cen,Ab | CC | Ins |
| 63 | Animal Medical Center | New York, N Y | Chapman, Evans & Delehanty | Gillman-Roos-Pesce Corp | ..... | 1961 | 350 | ..... | Cen,Ab | CC | Ins |
| 64 | Calif Ins of Tech, Keck Lab | Pasadena, Calif | John Freeman | Kilpatrick & Co | New | 1961 | 336 | ..... | Cen,Ab | CC | Ins |
| 65 | First National Bank | Jackson, Miss | Lomax, North & Beasley | South Central Htg & Plbg Co | ..... | 1961 | 336 | ..... | Cen,Ab | CC | OB |
| 66 | John Hancock Building | New Orleans, La | Syska & Hennessy Inc | Mayer Godchaux | New | 1961 | 330 | 88 | Cen,Ab | CC | OB |
| 67 | Borg-Warner Corp, Norge Div | Fort Smith, Ark | ..... | ..... | New | ..... | 330 | ..... | Cen,Ab | YO | OB |
| 68 | University of California[4] | Davis, Calif | Bayha, Weir & Finalto | M R Carpenter Inc | New | 1961 | 330 | 60 | Cen | WE | Ins |
| 69 | Jewish Hospital | Louisville, Ky | E R Ronald & Assoc | F W Owens Co & Std Engrg Co | New | 1961 | 327 | 120 | Cen | TR | Hosp |
| 70 | St Louis County Hospital | Clayton, Mo | Leo A Daly Co | Natkin & Co | New | 1961 | 320 | 102 | Cen,Ab | YO | Hosp |
| 71 | Carnegie Institute of Technology | Pittsburgh, Pa | Gatter & Diehl | Limbach Co | New | 1961 | 310 | ..... | Cen,Ab | YO | Ins |
| 72 | Air Route Traffic Control Center | Olathe, Kansas | FAA | Natkin & Co | New | 1961 | 308 | ..... | Cen,Ab | CC | OB |
| 73 | May-Lee Building | Cleveland, O | Robert Halverstadt & Assoc | The Feldman Brothers Co | New | 1960 | 303 | 100 | Pkg,Cen | CC | OB |
| 74 | U S Army, Brooklyn Army Terminal | Brooklyn, N Y | Pope & Evans | Nicholas Meschia | New | 1961 | 300 | 60 | Cen,Pkg,Ab | TR | OB |
| 75 | United California Bank, EDPC | Los Angeles, Calif | Levine & McCann | Air Conditioning Co Inc | New | 12-61 | 300 | 50 | Cen | CC | OB |
| 76 | Dillingham Transportation Bldg | Honolulu, Hawaii | Robert E Hamilton | Sam P Wallace of the Pacific Ltd | Ex | ..... | 300 | ..... | Cen,CO | TR,DH | OB |
| 77 | Fidelity & Casualty Co of N Y | Los Angeles, Calif | ..... | Pierce Engrg Co | ..... | ..... | 300 | 84 | Cen | CC | OB |
| 78 | Convair Aircraft | Fort Worth, Texas | Turnbull, Inc | Jack Flowers | New | ..... | 300 | ..... | Cen,CO | YO | IP |
| 79 | State Museum Bldg | Springfield, Ill | Beling Engrg Consultants | J F Weiskopf Plbg | New | 1961 | 300 | 110 | Cen,Ab | CC | Ins |
| 80 | Southwestern Bell Telephone Co | St Louis, Mo | Toensfeldt & Horch, Inc | Shure-Richardson, Inc | Add | 1-62 | 288 | ..... | Cen | YO | OB |
| 81 | Madison Heights Bldg | Memphis, Tenn | Allen & Hoshall | Cook & Nichol A C & Htg Inc | New | 1962 | 280 | 137 | Cen | CC | OB |
| 82 | College Hill Medical Building | Wichita, Kansas | Central Air Conditioning Co, Inc | Central Air Conditioning Co Inc | New | 1961 | 275 | 104 | Cen,Ab[8] | CC | Ins |
| 83 | Employment Security Bldg | Olympia, Wash | Harmon, Pray & Detrich | Capitol Plbg & Htg Co Inc | New | 1961 | 270 | 81.6 | Cen,Ab | CC | OB |
| 84 | Reader's Digest | Westmont, Canada | Seymour Levine, P Eng | Thermo Design Inc | New | 1961 | 260 | ..... | Cen | CC | OB |
| 85 | Foote Mineral Co | Exton, Pa | Voorhees, Walker, Smith & Smith | Ambrose-Augusterfer Corp | New | 1961 | 260 | ..... | Cen,Ab | CC | Lab |
| 86 | Asbury Methodist Hospital | Minneapolis, Minn | Ellerbe & Co | Belden Porter | Ex | 1961 | 250 | ..... | Cen,Ab | CC | Hosp |
| 87 | South Park School | Beaumont, Texas | Goleman & Rolfe | Har-con Engineering Inc | New | 1961 | 250 | ..... | Cen | CC | Ins |
| 88 | 1545 Tenth St, NW | Washington, D C | Shefferman & Bigelson | Wm H Singleton Co | New | 9-61 | 250 | 150 | Cen | CC | Apt |
| 89 | General Electric Co | Waynesboro, Va | Whitman Requardt & Assoc | Southeastern Const Co | Ex | 1961 | 250 | 31 | Pkg,Cen,CO | AB | OB |
| 90 | Riverside Health Center | Riverside, Calif | Storms & Lowe | J Q Plumbing & Heating | New | 1962 | 243 | 70 | Cen,CO | CC | OB |
| 91 | U of Missouri, Classroom Bldg | Columbia, Mo | William Cassell | Natkin & Co | New | 1961 | 240 | 62.6 | Cen,Ab | CC | Ins |
| 92 | Pharr Senior High School | Pharr, Texas | Madeley & Winans | Coastal Engineering Inc | New | 1961 | 240 | 89.3 | Cen,Ab | CC | Ins |
| 93 | Washington County Hospital | Fayetteville, Ark | H Lyman Cauvel | Mechanical Contractors Inc | New | 12-61 | 236 | ..... | Cen,Ab | CC | Hosp |
| 94 | Southern Bell Telephone & Telegraph | Montgomery, Ala | Harry Jeffcoat Jr | Shook & Fletcher Supply Co | New | 1961 | 230 | 45.6 | Cen | CC | IP |
| 95 | Home Insurance Office Bldg | Honolulu, Hawaii | Robert E Hamilton | Sam P Wallace of the Pacific Ltd | Ex | 1961 | 230 | ..... | Cen,CO | CC,AB,DH | OB |
| 96 | Carl M Loeb, Rhoades & Co | New York, N Y | Walter H Martin, ME | Anderson, Ziegler, O'Neill | New | 1960 | 225 | 48 | Cen | WE | OB |
| 97 | Pizitz Roebuck Store | Birmingham, Ala | James A Evans | Hardy Corp | New | 1961 | 225 | 65 | Cen | WO | Dpt |
| 98 | Westport High School | Louisville, Ky | E R Ronald & Assoc | Ward Engrg Co | New | 1961 | 215 | ..... | Cen | CC | Ins |
| 99 | Book-of-the-Month Club, Inc | New York, N Y | Walter H Martin, ME | Almirall & Co | New | 1960 | 210 | 60 | Cen,Ab | CC | OB |
| 100 | Pilot Life Insurance Co | Sedgefield, N C | McMinn, Norfleet & Wicker | W H Sullivan Co Inc | New | 1962 | 206 | 61.1 | Pkg,Cen | CC | OB |
| 101 | U S Post Office & Court House | Victoria, Texas | ..... | Har-con Engineering Inc | New | 1961 | 200 | ..... | Cen,Ab | CC | OB |
| 102 | Howard Park Hospital | Queens, N Y, N Y | Charles Wurmfeld | Kool Air System | ..... | ..... | 200 | ..... | Cen,Ab | CC | Hosp |
| 103 | Bowen Ifco Inc | Houston, Texas | Dolen-Tanner Co | Dolen-Tanner Co | Ex | 1960 | 180 | ..... | Cen | YO | IP |
| 104 | Ames Plaza Shopping Center | Omaha, Neb | ..... | Sol Lewis Engrg Co | New | 1961 | 175 | ..... | Cen,Ab[14] | CC | Cmr |
| 105 | Princess Kaiulani Hotel | Honolulu, Hawaii | Robert E Hamilton | Sam P Wallace of the Pacific Ltd | Ex | ..... | 170 | ..... | Cen,CO | TR,AB,AL | Ho |
| 106 | First State Bank | Abilene, Texas | Tippett & Gee | Abilene Air Conditioning | New | 1960 | 170 | 57 | Cen,Ab | YO | OB |
| 107 | Lippincott Bldg | Philadelphia, Pa | Paul H Yoemans | William M Anderson | Ex | 3-61 | 165 | 67.5 | Cen[14] | YO | OB |
| 108 | Florida National Bank | Orlando, Fla | .....[17] | IMEC of Florida, Inc | New | 1961 | 165 | ..... | Cen | CC | OB |
| 109 | Rubins Fine Furniture | Philadelphia, Pa | Jos C Greyson & Assoc | Superior Ht & Air Conditioning | Ex | 1961 | 159 | ..... | Pkg | GE | Dpt |
| 110 | Notre Dame Moreau Infirmary | South Bend, Ind | Wolfarth | Shambaugh & Son, Inc | New | 1961 | 158 | ..... | Cen,Ab | CC | Ins |
| 111 | Geigy Laboratories | Cranston, R I | Anderson & Nichols | Hart Engrg Co | New | 1961 | 154 | ..... | Cen,Ab | CC | Lab |
| 112 | Illinois Tool Works Inc, Conex Div | Desplaines, Ill | The Austin Co | The Austin Co | New | 1961 | 152 | 25 | Cen,Ab | CC | IP,OB |
| 113 | First Federal Savings & Loan Assn | Raleigh, N C | Howard T Musick | Stahl-Rider Inc | ..... | ..... | 150 | 40 | Cen | CC | OB |
| 114 | Kendall Co, Adhesive Center | Franklin, Ky | Giffels & Rossetti, Inc | ..... | New | ..... | 150 | ..... | Cen | TR,YO | IP,OB |
| 115 | American Telephone & Telegraph[16] | Frederick, Md | Jaros, Baum & Bolles | Wm H Singleton | New | 9-61 | 150 | 20 | Cen,CO | CC | IP |
| 116 | Children's Hospital | Birmingham, Ala | James A Evans | S A Brown Co | New | 6-61 | ..... | ..... | Cen | TR | Hosp |

MANUFACTURERS

AAF - American Air Filter Co Inc
AB - American Blower, Div of American Standard
AC - Allis-Chalmers Mfg Co
AE - Acme Engrg & Mfg Corp
AL - Aladdin Industries, Inc
AM - Air-Maze Corp
AR - Armstrong Cork Co
BAC - Baltimore Aircoil Co, Inc
BAN - Bahnson Co
BC - Barber Coleman Co, Controls Div
BF - Buffalo Forge Co
BR - Browning Mfg Co
BU - Burke & Co
BY - Belcher-Young Inc
CC - Carrier Corp
CCF - Cooling Corp of Florida
CE - Century Electric Co
CFC - Cambridge Filter Corp
CHB - Chicago Blower Corp
CL - Clarage Fan Co
CON - Continental Air Filters, Inc
DE - Dryer Electric
DH - Drayer Hansen Div
DO - Dodge Mfg Corp
DOL - Dollinger Corp
EA - Electro-Air Cleaner Co, Inc
ED - Electro-Dynamic Div of General Dynamics Corp
EKC - E K Campbell Co
EL - Elliott Co
EM - Electric Machinery Mfg Co
FA - Farr Co
FG - Fibre Glass Div, Ferro Corp
FM - Fairbanks, Morse & Co
FP - Fluor Products Co
FQ - Fedders-Quigan Corp
FR - Fram Corp
FW - Foster Wheeler Corp
GA - Gallaher Co
GB - Gustin-Bacon Mfg Co
GE - General Electric Co
GF - E D Goodfellow & Co
HC - Havens Cooling Towers Div
HE - Howell Electric Co
IA - Industrial Acoustics Inc
IE - Ideal Electric & Mfg Co
JM - Johns-Manville
JS - Johnson Service Co
K - Kerfund Co, Inc
KE - Kennard Div
LA - Louis Allis Co
LC - Lamson Corp, Billmyre Blower Div
LH - Lillie-Hoffman Cooling Towers Inc
MC - Marley Co
MCC - Marlo Coil Co
McQ - McQuay, Inc
MH - Minneapolis-Honeywell Regulator Co
MI - Mason Industries
MIW - Murray Iron Works Co
MNP - Marshall, Neal & Pauley
NYB - New York Blower Co
OC - Owens-Corning Fiberglas Corp
P - J F Pritchard & Co
PCM - Phillip Carey Mfg Co
PCT - Phillips Cooling Tower Co
PE - Peerless Electric Co
PR - Powers Regulator Co
RC - Recold Corp
RE - Reliance Electric & Engrg Co
SW - Sturtevant Div, Westinghouse Electric Corp
SWT - Swartwout Co

# and institutional air-conditioning systems

| REFRIGERATION EQUIPMENT | | | | | | | | | | | COOLING TOWERS | | | | | | | | AIR CLEANERS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. new units | Compressor type | Rpm | Refrigerant | Compressor drive | Drive hp | Drive manufacturer | H2O to coils, F | H2O from coils, F | Cooling medium | Condenser type | No. of towers | Manufacturer | Capacity, gpm | Cooling range, F | Wet bulb temp, F | Fill | Coating | Cooling water treatment | No. of cleaners | Manufacturer | Type | Ductwork type | Project Number |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 45 | 53 | CW | WC | 2 | CC | 1,283 | 104-85 | 78 | Rdw,Pl | ..... | CSA | ...[1] | OC | Fl | Rec,SD,LV | 58 |
| 1 | Ce | ..... | ..... | M | 300 | ..... | ..... | ..... | CW | WC | 1 | MC | 1,050 | 95-85 | 78 | Rdw | ..... | CSA | ... | AAF | ..... | Rec | 59 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 42 | 50 | CW | WC | 1 | MC | 1,300 | 96-80 | 70 | Rdw | ..... | CSA | 23 | AAF | Fl | Rec,LV | 60 |
| 1 | Ce | ..... | ..... | M | 350 | CC | 44 | 52 | CW | WC | 1 | CC | 1,050 | 95-85 | 78 | Pl | ..... | CSA | 2 | AAF | Fl,Pr | Rec,Cc,SD[2] | 61 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 44 | 52 | CW | WC | 1 | FP | 2,600 | 102-85 | 78 | Rdw | ..... | CSA | 5 | CFC | Fl | Rec,LV,DD | 62 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 46 | 58 | CW | WC | 1 | CC | 1,200 | 102.5-85 | 78 | ..... | ..... | SC | ... | AAF | Fl | Rec,Cc,[2,3] | 63 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 45 | 55 | CW | WC | 2 | FP | 1,200 | 102-85 | 75 | Rdw | ..... | ..... | ... | AAF | Fl | Rec,SD,LV | 64 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 42 | 55 | CW | WC | 1 | MC | 1,288 | 102.5-86 | 79 | Rdw | ..... | SC | ... | ..... | ..... | Rec[2,3] | 65 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 45.5 | 55.5 | CW | WC | 1 | PCT | 1,200 | 103.6-86.2 | 80 | Rdw | ..... | ..... | ... | AAF | Fl | Rec,HV,Cc | 66 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 45 | 55 | CW | ..... | 1 | MC | 1,190 | 103-85 | 76 | Rdw | ..... | CSA | 72 | OC | Fl | Rec,SD,LV | 67 |
| 3 | Rp | 1150 | R-12 | M | ..... | WE | 43.2 | 48.7 | CW | WC | 2 | MC | 630[5] | 90-80 | 72 | Rdw | ..... | CSA | ... | CON | Fl | Rec,LV | 68 |
| 1 | Ce | 3600 | R-11 | M | ..... | ..... | 42 | 53.2 | CW | WC | 1 | MC | 1,440 | 95-85 | 78 | Rdw | ..... | CSA | 2 | AAF | Fl,Wa,Pr | Rec,Cc[2] | 69 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 44 | 54 | CW | WC | 1 | MC | ..... | ..... | 78 | Rdw | ..... | SC | 28 | CFC | Fl | Rec,Cc[2] | 70 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 44 | 55.6 | CW | N | 1 | ..... | 1,225 | 102-86 | 75 | Rdw | ..... | SC | ... | AM | Fl | Rec | 71 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 45 | 57 | CW | ..... | 1 | MC | 1,050 | 102-85 | 78 | Rdw | ..... | CSA | 144 | FA | ..... | Rec,LV | 72 |
| 1 | Ce | ..... | R-113 | M | ..... | ..... | 42 | 55.7 | CW | WC | 1 | P | 900 | 95-85 | 77 | Rdw | ..... | CSA | 3 | AAF | Fl | Rec,SD,DD | 73 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 46 | 56 | CW | WC | 1 | P | 900 | 95-85 | 78 | Rdw | ..... | ..... | ... | KE | Fl | Rec | 74 |
| 2 | Ce | ..... | ..... | ..... | ..... | ..... | 43 | 55 | CW | WC | 1 | FP | ..... | ..... | ... | Rdw | ..... | ..... | ... | ..... | Fl | Rec,LV | 75 |
| 1 | Ce | 3600 | R-11 | M | 296 | LA | 40 | 50 | CW | WC | 1 | MC | 900 | 95-85 | 78 | Rdw | ..... | SC | ... | ..... | ..... | Rec,LV,DD | 76 |
| 1 | Ce | ..... | R-113 | M | 300 | ..... | 45 | 55 | CW | WC | 1 | P | 900 | 95-85 | 75 | Rdw | ..... | SC | ... | BU | Fl,DC | Rec,Cc[2] | 77 |
| 2 | Ce,SS | ..... | R-11 | M | 120[18] | YO | 42 | 50 | CW[6] | WC | 1 | FP | 1,100 | 95-85 | 78 | Rdw | ..... | ..... | 12 | FA | Fl | HV,SD,Cc | 78 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 45 | 53 | CW | WC | 1 | MC | 1,080 | 101-85 | 78 | Rdw | AsC | CSA | 3 | AAF | Pr | HV,Cc | 79 |
| 1 | Ce | 3600 | R-11 | M | 275 | LA | 50 | 60 | CW | WC | 1 | LH | 1,800 | 95-85 | 78 | Rdw | G | CSA | 8 | CON | Fl | Rec,SD,LV | 80 |
| 2 | Ce,Mu | 3600 | R-11 | M | 180[7] | ..... | 45 | 60 | CW | WC | 3 | GF | 1,200 | 95-85 | 78 | Rdw | G | ..... | 1 | AAF | Fl | Rec,SD[2] | 81 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 45 | 53 | CW | WC | 1 | CC | ..... | ..... | 78 | ..... | ..... | ..... | ... | ..... | ..... | Rec,LV | 82 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 42 | 52 | CW | ..... | 1 | MC | 1,070 | 95-80 | 65 | Rdw | ..... | CSA | 126 | AAF | ..... | .....[2,3] | 83 |
| 1 | Ce | ..... | R-11 | M | ..... | ..... | 44 | 55 | CW | WC | 1 | MC | 753 | 95-85 | 75 | Rdw | ..... | CSA | 2 | AAF | Fl | ..... | 84 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 45 | 55 | CW | WC | 1 | MC | 1,025 | 102-85 | 78 | Rdw | ..... | SC | ... | AAF | Wa,Fl | HV,SD | 85 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 42 | 52 | CW | WC | Well | ..... | ..... | ..... | ... | ..... | ..... | ..... | ... | AAF | Fl | Rec,LV | 86 |
| 1 | Ce | 3600 | ..... | M | ..... | ..... | 45 | 55 | CW | WC | 1 | MC | 1,000 | 93.5-86 | 80 | Rdw | ..... | ..... | ... | ..... | Fl | HV,DD | 87 |
| 1 | Ce,Mu | 3600 | R-11 | M | 250 | ..... | 45 | 53 | CW | WC | 1 | BAC | 750 | 95-85 | 78 | Mo | ..... | CSA | ... | ..... | Fl | Rec,SD,LV | 88 |
| 1 | Ce | ..... | R-113 | M | 250 | GE | 44 | 49 | CW | WC | 1 | BAC | 780 | 82-76 | 76 | ..... | ..... | CSA | ... | ..... | Fl | Rec,LV | 89 |
| 1 | Ce,SS | 3550 | R-113 | M | ..... | CC | 42 | 54 | CW | WC | 1 | MC | 730 | 95-85 | 75 | Rdw | G | SC | 50 | BU | Fl | Rec,LV[3] | 90 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 45 | 50 | CW | WC | 1 | MC | 1,010 | 101-85 | 78 | Rdw | ..... | SC | 7 | FR | Fl | SD | 91 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 45.0 | 52.2 | CW | WC | 1 | MC | 1,000 | 100-85 | 80 | Rdw | As | CSA | ... | ..... | ..... | Rec,LV | 92 |
| ... | ..... | ..... | ..... | ..... | ..... | ..... | 42 | 50 | CW | ..... | 1 | MC | 945 | 101-85 | 78 | Rdw | ..... | ..... | 2 | BF,AAF | Wa,Fl | Rec,LV | 93 |
| 1 | Ce | 3800 | R-11 | M | ..... | ..... | 45 | 54 | CW | WC | 1 | MC | 690 | 95-85 | 78 | ..... | ..... | ..... | 4 | ..... | Fl | Rec,SD,LV | 94 |
| 1 | Ce | 3600 | R-113 | M | ..... | ..... | 40 | 50 | CW | WC | 1 | MC | 690 | 95-85 | 78 | Rdw | ..... | ..... | 1 | FA | Fl,Wa | Rec,LV,DD | 95 |
| 3 | Ce | 1750 | ..... | ..... | ..... | ..... | 45 | 55 | CW | WC | 3 | BAC | 675 | 95-85 | 78 | Mo | G | CSA | 12 | CFC,AAF | Fl | Rec,SD,LV[2] | 96 |
| 1 | Ce | 3600 | F-114 | M | 250 | ..... | 45 | 51.4 | CW | WC | 1 | MC | 675 | 95-86 | 78 | Rdw | ..... | CSA | 3 | CFC | Fl | Rec,LV | 97 |
| 2 | Ce,Rp | 3500[9] | R-113 | M | 220 | ..... | 45 | 53 | CW | WC | 2 | MC,FP | 45[10] | 95-85 | 78 | Rdw | ..... | ..... | 65 | AAF | Fl | Rec,SD,LV | 98 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 45 | 55 | CW | WC | 1 | BAC | 735 | 102-85 | 78 | Mo | G | CSA | 9 | AAF | Fl | Rec,SD,LV | 99 |
| 2 | Ce[11] | 3500 | R-113 | ..... | ..... | ..... | 45 | 53 | CW | WC,Air | 1 | P | 633 | 95-85 | 78 | Rdw | ..... | CSA | ... | ..... | DC | Re,Cc[12] | 100 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 45 | 55 | CW | WC | 2 | LH | ..... | 94-86 | 80 | Rdw | ..... | ..... | ... | ..... | Fl | Rec | 101 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 45 | 55 | CW | ..... | 2 | HC | 550 | 103-85 | 78 | Rdw | ..... | SC | 8 | CC | Fl | Rec,SD,LV | 102 |
| 3 | Rp | 1750 | R-22 | M | 60[18] | ..... | ..... | ..... | DER | WC | 1 | P | 720 | 93.5-86 | 80 | Rdw | ..... | ..... | ... | FA | Fl | Rec,LV | 103 |
| ... | ..... | ..... | ..... | ..... | ..... | ..... | 50 | 57 | CW | WC | 1 | CC | 600 | 107-87 | 78 | Pl | ..... | ..... | ... | ..... | Fl | Rec,SD | 104 |
| 1 | Ce | 3600 | R-113 | M | 175 | LA | 40 | 46 | CW | WC | 1 | MC | 540 | 95-85 | 78 | Rdw | ..... | SC | ... | ..... | ..... | Rec,LV,DD | 105 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 42 | 50 | CW | WC | 1 | MC | 610 | 103-85 | 76 | Rdw | ..... | SC | ... | ..... | ..... | Rec,Cc[2] | 106 |
| 1 | Ce,SS | 10,000 | R-11 | M | 150 | ..... | 45 | 55 | CW | WC | 1 | FP | 450 | 95-85 | 78 | Rdw | ..... | ..... | ... | ..... | ..... | Rec,LV | 107 |
| 1 | Ce | 3600 | R-113 | ..... | ..... | ..... | 46 | 50.3 | CW | WC | 1 | CCF | 500 | 95-85 | 78 | Rdw | ..... | SC | ... | ..... | Fl | Rec | 108 |
| 6 | Rp | 1750 | R-22 | ..... | ..... | ..... | ..... | ..... | DER | WC | 1 | ..... | 585 | 100-88 | 95 | Rdw | ..... | CSA | ... | ..... | ..... | Rec,SD,LV | 109 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | CW | WC | Well | ..... | ..... | ..... | ... | ..... | ..... | ..... | ... | ..... | Fl | Rec,Cc[2] | 110 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | CW[15] | ..... | Well | ..... | ..... | ..... | ... | ..... | ..... | ..... | N | ..... | ..... | Rec,SD,LV | 111 |
| .... | ..... | ..... | ..... | ..... | ..... | ..... | 42 | 57 | CW | WC | 1 | MC | 552 | 102-85 | 77 | Rdw | N | CSA | 3 | AAF | Fl | Rec,SD,LV | 112 |
| 1 | Ce | 3500 | R-11 | M | ..... | ..... | 44 | 54 | CW | WC | 1 | MC | 450 | 95-85 | 78 | Rdw | ..... | SC | 2 | TRI | ..... | HV,DD,Cc | 113 |
| 5 | Rp | ..... | R-12,R-22 | M | 60 | ..... | 50 | 70 | DER | Air | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | 84 | OC | Fl | Rec,SD,LV | 114 |
| 2 | Ce | 3600 | R-11 | M | 150[18] | ..... | 42 | 52 | CW | WC | 2 | MCC | ..... | 96-86 | 78 | Mo | G | CSA | 40 | CFC | Fl | Rec,SD,LV | 115 |
| 1 | Ce | 3600 | R-11 | M | ..... | LA | 45 | Var | CW | WC | 1 | BY | ..... | 95-86 | 78 | Rdw | ..... | CSA | 9 | AAF | Fl,Pr | Rec,Cc[12] | 116 |

THE - Thermal Engrg Corp
TR - Trane Co
TRI - Trion, Inc
TST - Terry Steam Turbine Co
UA - United Air Conditioning Corp
VE - Vibration Eliminator Co
VM - Vibration Mountings, Inc
WE - Westinghouse Electric Corp
WEC - Wagner Electric Corp
WO - Worthington Corp
YO - York Div, Borg-Warner Corp

SYMBOLS USED ABOVE

Ab - Absorption
Add - Addition
Air - Air cooled
Al - Aluminum foil
Apt - Apartment
As - Asbestos
AsC - Asbestos-cement
Bl - Blanket
Bo - Board
Cc - Circular conduit
Ce - Centrifugal
Cen - Central
Cer - Ceramic
Ck - Cork
Cmr - Commercial center
CO - Cooling only
Com - Compression
CS - Central scanning
CSA - Chemicals self administered
CW - Chilled water
DC - Dust collector
DD - Dual duct
DER - Direct expansion refrigerant
Doj - Done on the job
Dpt - Department store
E - Electric
El - Electronic
Ex - Existing plant or equipment
F - Freon
Fg - Fiber glass
Fl - Filter
Foam - Foam glass
FSA - Fabricated sound absorbers
G - Galvanized
H - Humidity
Ho - Hotel
Hosp - Hospital
HV - High velocity
ID - Inside duct
Imp - Impregnated paper
IMR - Inside machinery room
Ins - Institution
IP - Industrial Plant
Lab - Laboratory, research bldg
LV - Low velocity
M - Metal
MC - Mastic coating
Me - Metal
Mu - Multi-stage
N - None
Ne - Near equipment
NG - At or near grill
OB - Office building
Pl - Plastic
Pn - Pneumatic
Pr - Precipitator
Pre - Preseeled
R - Refrigerant
Rdw - Redwood
Rec - Rectangular duct
Ris - Rubber-in-shear
Rp - Reciprocating

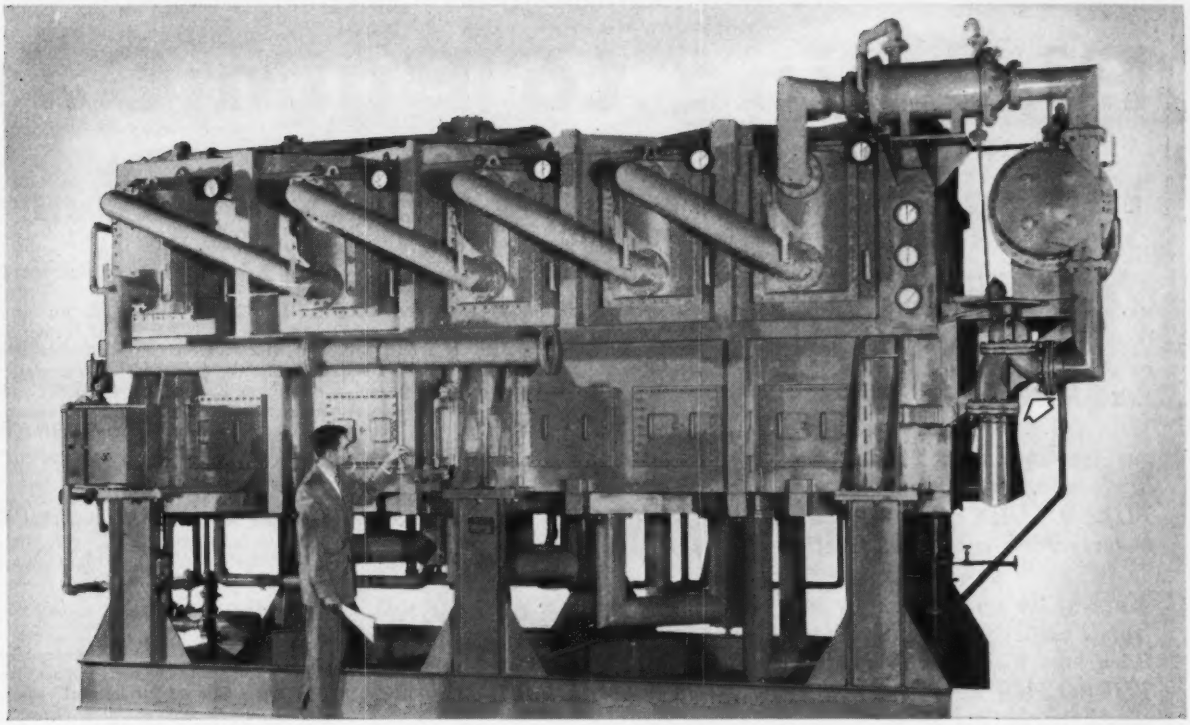
# Air-conditioning systems — Table 2 continued

Compiled by: R H Marks, Associate Editor

| Project Number | AIR HANDLING EQUIPMENT: SUPPLY FANS: Number | Capacity 1000 cfm | Rpm | Manufacturer | Drive hp | Drive rpm | Drive manufacturer | RETURN FANS: Number | Capacity 1000 cfm | Rpm | Manufacturer | Drive hp | Drive rpm | Drive manufacturer | INSULATION: Type | Manufacturer | Vapor seal | CONTROLS: Manufacturer | Type | Location | VIBRATION MOUNTS: Manufacturer | Type | Sound absorbent |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58 | 2 | 10.4[18] | 1750 | CC | 5 | Var | CC | 3 | 22.8 | 1750 | ..... | 1-3 | Var | ..... | Fg | ..... | ..... | ..... | Tp,H,Pn | NG | K | Ris,Ck | ID,IMR |
| 59 | 6 | 70[18] | ..... | BF | 40 | ..... | ..... | 2 | 90[18] | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Al | JS | Tp,H,Pn | ..... | ..... | ..... | ..... |
| 60 | 14 | 150 | ..... | CC | ..... | ..... | ..... | 1 | ..... | ..... | CC | 40 | ..... | ..... | Fg | ..... | Al | PR | Tp,H,Pn | ..... | ..... | Sp | ID,FSA |
| 61 | 2 | ..... | ..... | CC | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | JM | Doj,Imp | MH | Tp,H,Pn | ..... | ..... | Ris,Ck | .....[19] |
| 62 | 5 | 63.3 | ..... | AB | 65 | ..... | BR | 10 | 59 | ..... | AB | 22 | ..... | BR | Fg | OC | Al | JS | Tp,H,Pn | NG | K,VE | Sp | ID |
| 63 | 7 | 85[20] | ..... | KE | ..... | ..... | ..... | 3 | 56 | ..... | KE | ..... | ..... | ..... | Fg | ..... | Doj | PR | Pn | NG,CS | VM | Sp | ID,FSA |
| 64 | 2 | 62 | 440 | NYB | 15[18] | 1750 | ..... | 2 | 24 | 700 | NYB | 10[18] | 1750 | ..... | Fg | ..... | ..... | JS | Tp,Pn | NG | ..... | Sp | ID |
| 65 | 5 | 98 | .....[21] | CC | 145 | ..... | ..... | 3 | 67.2 | .....[22] | CC | 25 | ..... | ..... | Fg | ..... | ..... | JS | Tp,H,Pn | CS | ..... | Sp,Ris,Ck | ID |
| 66 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | OC | ..... | JS | Pn | ..... | VE | Ris | ID |
| 67 | 5 | 113[20] | 750 | YO | 95[20] | 1150 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | OC | MC,Doj,Imp | MH | Tp,Pn,E | NG,CS | ..... | Ris,Ck | ..... |
| 68 | 6 | 70[20] | .....[23] | AB | 3-10 | 1750 | GE | 38 | 40 | .....[24] | AB | .25-.75 | 1750 | GE | Fg | GB,OC | Al | MH | Tp,Pn | ..... | ..... | Ris | ID |
| 69 | 6 | 19.5[20] | 3000 | ..... | 36[20] | 3450 | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | MC,Doj | MH | Tp,Pn | Ne | K | Sp | ID |
| 70 | 1 | 27.5 | 1480 | CHB | 60 | ..... | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg,Bl | AR | Doj | BC | Tp,H,El | NG,CS | ..... | Ris | FSA |
| 71 | 8 | ..... | ..... | YO | 10-30 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 72 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | AR | AsC | MH | Tp,H,Pn | NG,CS | ..... | Ris | ID,FSA |
| 73 | 4[25] | ..... | ..... | BF | ..... | 1750 | CE | 3[26] | ..... | ..... | BF | ..... | 1750 | CE | Fg | ..... | Al,Doj | JS | Tp,Pn | CS | ..... | Ris | N |
| 74 | 5 | 50 | ..... | KE | ..... | ..... | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Pre,Doj | BC | Tp,H,El | NG | ..... | ..... | ..... |
| 75 | 4 | 78[20] | ..... | ..... | ..... | ..... | ..... | 4 | 65[20] | ..... | ..... | ..... | ..... | ..... | Fg | ..... | ..... | MH | Tp,H,Pn,El | CS | ..... | Sp,Ris | ..... |
| 76 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | MC | ..... | Tp,E | CS | ..... | ..... | ..... |
| 77 | 7 | 100 | 1167 | CHB | 100 | 1750 | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg,Bl | GB | Doj | JS | Tp,Pn | CS | ..... | Sp,Ris,Ck | ID,FSA |
| 78 | 12 | .....[27] | 3500 | LC | 60 | 3500 | ED | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Doj | JS | Tp,Pn | CS | ..... | Sp,Ck | N |
| 79 | 3 | 73.8 | ..... | CC | 20-50 | ..... | AC | 7 | 70 | ..... | CC | 1-20 | ..... | AC | Fg | GB | Imp | MH | Tp,H,Pn | CS | ..... | Ris | ID,FSA |
| 80 | 8 | 300[20] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg,Bo | GB | Pre,Doj | MH | Tp | ..... | ..... | Ris | ..... |
| 81 | 1 | 19.7 | 1000 | ..... | 25 | 1750 | ED | 1 | 12 | 710 | DE | 3 | 1800 | ..... | Fg | ..... | Al | MH | Tp,Pn,E,El | ..... | VM | Sp | ID |
| 82 | .....[28] | .....[28] | ..... | CC | .....[28] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg,Bl | ..... | ..... | JS | Tp,Pn | ..... | ..... | ..... | ..... |
| 83 | 2 | 72 | 1175 | CHB | 150 | 1200 | ..... | 1 | 108 | 561 | CHB | 75 | 1750 | ..... | Fg | OC | VP | JS | Tp,Pn | NG | VM | Sp | ID,FSA |
| 84 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 85 | 9 | ..... | ..... | CHB | Var | Var | GE | 56 | ..... | ..... | CHB | Var | Var | GE | Fg | OC | MC | PR | Pn | NG,CS | K | Sp | ID |
| 86 | 7 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Pre | MH | Tp,H,Pn | NG | ..... | Ris | N |
| 87 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Al,Doj | MH | Tp,Pn | NG,CS | K | Sp | ID,FSA |
| 88 | 375[29] | .3-.6 | 900 | FQ | .33 | 900 | ..... | 20 | .6-3 | Var | TR | .25-2 | 1750 | ..... | Fg | AR,OC | Pre,Doj,Imp | ..... | Tp,Pn,E | NG | Sev | Sp,Ris,Ck | ID |
| 89 | 8 | .....[27] | 240 | AB | 5 | 1750 | GE | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | JM | Al | MH | Tp,H,Pn | CS | K | Sp | ID,FSA |
| 90 | 2 | 38.1[18] | 573 | AB | 20[18] | 1725 | ..... | 2 | 27.4[18] | 556 | AB | 10[18] | 1725 | ..... | Fg,Bl | OC | .....[30] | JS | Tp,H,Pn | NG | K | Sp | ID,IMR |
| 91 | 8 | 72.7 | 600 | MCC | 5 | 1750 | CE | 8 | 72.7 | 600 | MCC | 5 | 1750 | CE | Fg,Bl | GB | Doj | BC | E | NG,CS | K | Ck | ID |
| 92 | 7 | 3.9-15 | ..... | THE | 2-7.5 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | OC | MC,Doj | JS | Pn | CS | ..... | Sp,Ck | ID |
| 93 | 7[31] | 39[20] | ..... | McQ | .3-7.5 | 1750 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | AR | Doj | MH | Tp,H,Pn | CS | VE | Sp,Ris | ID |
| 94 | 4 | 15 | 770 | CC | 10 | 1800 | CC | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | JM | Pre,Al | JS | Tp,H,Pn | ..... | VM | Ris | ..... |
| 95 | 1 | 46.2 | 250 | CHB | 15 | 1750 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | MC | BC | Tp,E | NG,CS | Var | Sp,Ris | ..... |
| 96 | 13 | 70 | ..... | ..... | ..... | ..... | ..... | 1 | 7 | ..... | AB | 2 | ..... | ..... | Fg | ..... | Al,Doj | MH | Tp,H,Pn | CS | VE | Ris | ..... |
| 97 | 3 | 101[20] | 600 | NYB | 70[20] | ..... | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | MC,VP | ..... | Tp,Pn | ..... | ..... | Sp,Ris | ID |
| 98 | 1 | 5.7 | ..... | CC | 5 | 1750 | ..... | 1 | 4.8 | ..... | AB | 1 | 1750 | ..... | Fg | ..... | MC,Doj,Imp | MH | Tp,Pn | NG | ..... | Ris | ID,FSA |
| 99 | 7 | 63[20] | ..... | AB,KE | ..... | ..... | ..... | 3 | 20[20] | ..... | AB | 10 | ..... | ..... | Fg | ..... | ..... | MH | Tp,H,Pn | CS | VE | Ris | ID |
| 100 | 12 | ..... | ..... | McQ | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | OC | Doj | JS | Tp,H,Pn | ..... | K | Ris,Ck | ..... |
| 101 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Al,Doj | BC | Tp,H,El | NG | K | Ris | ..... |
| 102 | 8 | 1.5-4.0 | Var | CC | 1-5 | 1800 | ED | 21 | .6-3.0 | Var | GA | .25-1 | Var | ..... | Bl,Bo[32] | JM | Pre,Doj,Al | PR | Tp,Pn | ..... | MI | Ris | ..... |
| 103 | 3 | 25[18] | ..... | YO | 10 | 1750 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | .....[13] | ..... | ..... | MH | Tp,E | NG | ..... | Sp | ..... |
| 104 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Al | MH | Tp,H,E | ..... | ..... | ..... | ..... |
| 105 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | MC | ..... | Pn,E | CS | ..... | Ris | ..... |
| 106 | 7 | 43.2 | ..... | YO,AB | .25-10 | .....[33] | AC | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | JM,OC | MC,Pre | JS | Pn | NG,CS | ..... | Ris | ID,FSA |
| 107 | .....[34] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | PR | Tp,Pn,E | NG | ..... | Sp | ..... |
| 108 | ..... | ..... | ..... | CC | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | MH | Pn | ..... | ..... | ..... | ..... |
| 109 | 6 | 6-30 | ..... | GE | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg,Bo | ..... | ..... | MH | Tp | NG,CS | ..... | Ck | IMR |
| 110 | 2[35] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | ..... | Doj,VP | .....[35] | Pn,El | CS | ..... | Ris | ID,FSA |
| 111 | 17 | 40 | .....[36] | TR | 1-3 | 1750 | GE | N | .....[38] | .....[38] | ..... | ..... | ..... | ..... | Fg,Bo | PCM | Doj | MH | Tp,H,Pn | CS | ..... | Ris | ID,FSA |
| 112 | 3 | .....[37] | .....[37] | TR | .....[37] | 1750 | ..... | 3 | ..... | ..... | TR | .....[38] | 1750 | ..... | Fg | ..... | Al | JS | Tp,H,Pn | ..... | TR | Ris | N |
| 113 | 2 | 45 | ..... | ..... | ..... | ..... | ..... | 2 | 40 | 650 | NYB | ..... | ..... | ..... | Fg,Bl | ..... | Al | JS | Tp,Pn | NG | ..... | Sp | ID,FSA |
| 114 | 4 | 78.9[20] | 750 | TR | 95[20] | 1150 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Fg | OC | MC,Doj,Imp | MH,JS | Tp,Pn,E | NG,CS | ..... | Ris,Ck | ..... |
| 115 | 3 | 85 | 700 | SW | 20[18] | 1750 | WE | N | ..... | ..... | ..... | ..... | ..... | ..... | Fg | OC | Pre,Doj,Imp | ..... | Tp,Pn,E | NG | VE | Sp,Ris,Ck | ID |
| 116 | 9 | ..... | ..... | TR | ..... | ..... | ..... | 30 | ..... | ..... | NYB | ..... | ..... | ..... | Fg | ..... | MC,Doj | JS | Tp,H,Pn | NG | ..... | Sp,Ris,Ck | ID,FSA |

SC - Service contract
SD - Single duct
Sev - Several
Sp - Springs
SS - Single stage
St - Steel
T - Turbine drive
Tp - Temperature
Tr - Transite
Var - Various, varies
VP - Vinyl plastic
Wa - Washer
WC - Water cooled
Well - Well water

1 - 1 per air unit in 3 pipe system
2 - Low velocity, high velocity
3 - Single duct, dual duct
4 - Biological Sciences Bldg No. 1
5 - And 390 gpm
6 - Cooling water 85 to 95 (two-stage)
7 - And 130 hp
8 - 4 pipe system supplying steam and chilled water to fan coil units
9 - And 1750 rpm
10 - And 400 gpm
11 - Plus reciprocating unit, 36 tons, 1750 rpm, using R-22
12 - Single duct, low velocity
13 - None-duct in conditioned space
14 - 3 pipe system to single unit coils
15 - With 50% glycol
16 - Underground Repeater Station
17 - James Gamble Rogers, Lamb eck & Fritz
18 - Each
19 - FD, IMR, FSA
20 - Total
21 - 690 to 1100 rpm
22 - 345 to 520 rpm
23 - 675 to 1100 rpm
24 - 600 to 1500 rpm
25 - 7300 cfm, 1210 rpm, 3 hp
14470 cfm, 1275 rpm, 10 hp
27400 cfm, 677 rpm, 5 hp
67200 cfm, 400 rpm, 30 hp
26 - 23300 cfm, 494 rpm, 5 hp
57100 cfm, 380 rpm, 9.2 hp
9940 cfm, 732 rpm, 2.4 hp
27 - 100 lbs per minute
28 - 56 at 800 cfm, .25 hp; 11 at 4,000 to 10,000 cfm, 1.5 to 5 hp
29 - Each air handling unit receives hot and chilled water
30 - Mastic coating in duct joints; vinyl plastic in plenums
31 - Plus 124 room units
32 - Performed for pipe
33 - 1140 to 1750 rpm
34 - 6 central cooling coils, 122 fan coils
35 - 1 high velocity: 10 Mcfm, 1800 rpm, CC, 20 hp fan drive, 1750 rpm, CC; 1 low velocity: 6.8 Mcfm, 820 rpm, CC, 5 hp fan drive, 1750 rpm, CC
36 - 600 to 1300 rpm
37 - 13870 cfm, 905 rpm, 7.5 hp
19500 cfm, 765 rpm, 10 hp
3360 cfm, 798 rpm, 1 hp
38 - 13100 cfm, 247 rpm, 5 hp
14625 cfm, 227 rpm, 5 hp
2240 cfm, 480 rpm, .33 hp



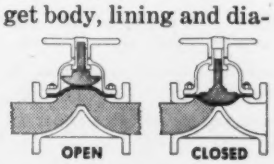
**ON LAND** At Salinas, a tourist center in Ecuador, this Cleaver-Brooks Flash Evaporator delivers 50,000 gallons of pure, distilled water every 24 hours. It is equipped with two 6", rubber lined, weir-type Grinnell-Saunders Diaphragm Valves — only one of which can be seen from this view.

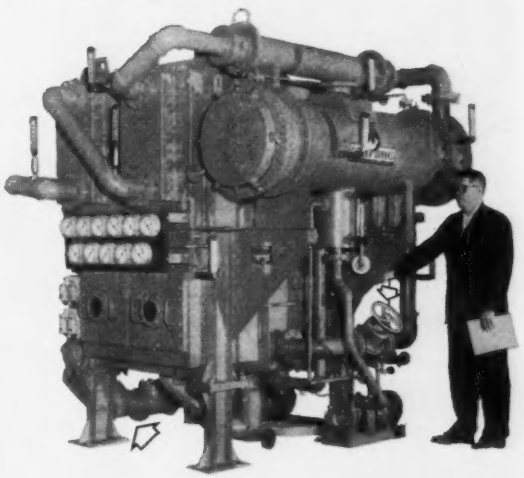
# Grinnell-Saunders Diaphragm Valves help convert salt water to fresh water

You can convert sea water to fresh water, in abundant supply, on land . . . or on shipboard, with flash evaporators made by Cleaver-Brooks Special Products, Inc., Waukesha, Wisconsin. Grinnell-Saunders Diaphragm Valves are used as original equipment on these distillation units because they offer positive, leak-tight closure; flow control in throttling position; corrosion-resistance.

You'll find Grinnell-Saunders valves widely used in other fields, too . . . petroleum, papermaking, chemical, food, compressed air . . . to mention a few.

The operating principle of the Grinnell valve is the feature which makes it so adaptable. The diaphragm lifts high for streamline flow in either direction; seals tight for positive closure against grit, scale, solid matter, pressure or vacuum. Bonnet mechanism is completely isolated at all times from the fluid in the line by the diaphragm, preventing corrosion and contamination. Smooth passage, without pockets, eliminates trapping of solids and reduces frictional resistance. And you can get body, lining and diaphragm materials to meet your particular service conditions. Get *all* the facts. Write Grinnell Company, Providence 1, R. I.



**AT SEA** The nuclear powered NS Savannah has two 16,000 gallons-per-day Cleaver-Brooks distillation units to supply the entire water requirements of crew and machinery. Each unit has two 4" Grinnell-Saunders Straightway Valves of ductile iron.

GRINNELL

Pipe, Fittings, Valves, Hangers, Heating and Piping Supplies
Branch Warehouses and Distributors From Coast To Coast


For more facts circle 826 on Reader Service card, p 197

# Planning to Burn Gas,

## *You can fire* ANY ONE or ALL THREE *in a*

*The Riley TURBO FURNACE is a major furnace design advance for the more efficient utilization of fuels. It is best known as a multifuel unit because of its ability to produce similar furnace exit gas temperatures with gas, oil, coal or other solid fuels. This phenomenon is due to natural gas burning in a TURBO FURNACE with a luminous flame similar to oil and coal. In a TURBO FURNACE, fuels are burned with extremely high turbulence at the furnace bottom.*

*Much of the unusual combustion efficiency results from opposed firing with Riley Directional Flame Burners which are specially designed for the TURBO FURNACE and for firing multiple fuels singly or in combination. These fuels may be pulverized coal, oil, gas, or other special solid fuels such as fluid coke or lignite.*

### Water Cooled Burner

The Riley Directional Flame Burner is designed for opposed firing on one level. Each Riley Directional Flame Burner is installed as a unit complete with water cooling tubes which are welded to the waterwall circulation system. The waterwall tube arrangement provides maximum cooling of directional vanes, nozzles and other burner parts and reduces to a minimum the possibility of slag adhesion when coal is being burned. No burner refractories are required.

### Coal Burning

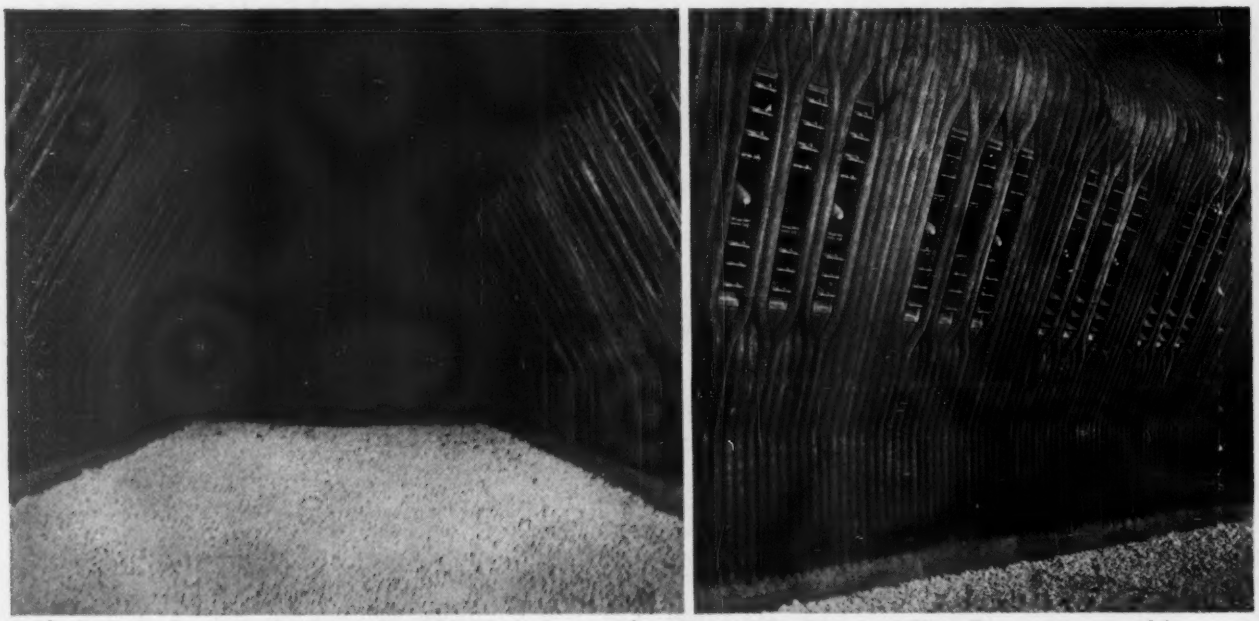
Two or three burner nozzles per burner are provided when coal or other solid fuels are to be burned. In this way the coal streams are more evenly distributed across the furnace to assure good mixing of fuel and air in the furnace.

### Oil Firing

A retractable type oil gun is inserted thru the center slot so as to provide complete mixing of the spray with the air stream. Oil can be burned with either steam or mechanical atomizing equipment.

### Gas Firing

Gas is fired thru guns of high alloy stainless steel. High capacity burners have a gun in each side slot. Gas guns can be installed for mechanical retraction.

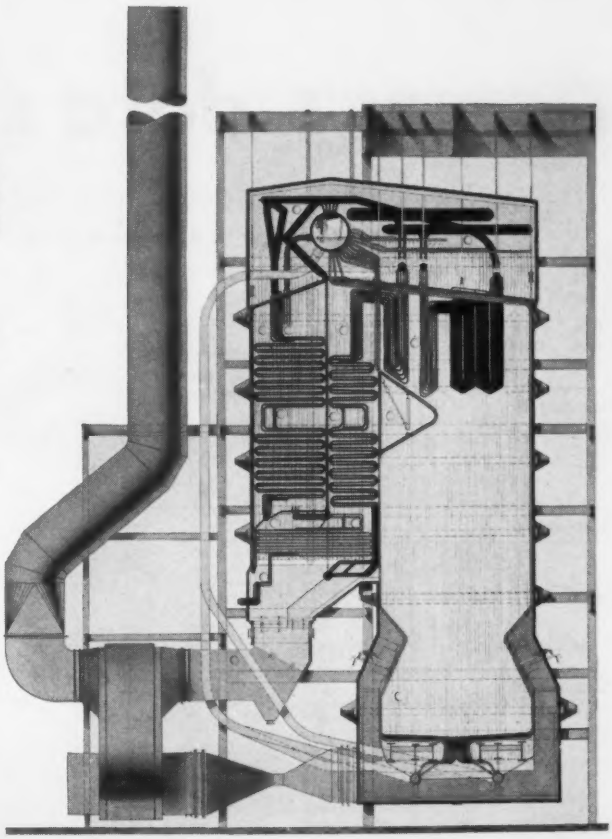


Inside the Turbo Furnace at Sterlington Steam Electric Station of Louisiana Power and Light Co. Overall width 54′—7⅞″, depth 24′—0-3/16″. No. 1 firebrick rubble covers the furnace floor. Twenty Riley Directional Flame Burners are arranged for opposed firing on front and rear walls. Burners are shop fabricated assemblies. Burner close-up shows directional vanes, two

**A RILEY TURBO FURNACE GIVES YOU THESE MONEY-SAVING ADVANTAGES**

- **The ability to fire multiple fuels: gas, oil and a wide range of solid fuels**
- **A low cost and quick conversion to solid fuels with initial gas/oil firing**
- **Higher heat release with lower overall structure**
- **Minimum Superheater/Reheater metal temperature variations across full width of furnace.**
- **No restrictions on furnace widths.**
- **One level burner operation.**

# Oil or Coal?
# TURBO FURNACE



### Directional Vanes

Each slot is provided with directional vanes to project secondary air into the furnace so as to secure the desired placement of flame for most effective combustion. The vanes above the burner centerline and those below each have separate controls. Vanes are made of high heat resisting alloy.

### Burner Shut-Off

Each burner has a separate secondary air shut-off damper which can be locally or remotely controlled.

### Riley Gas-Electric Ignitors

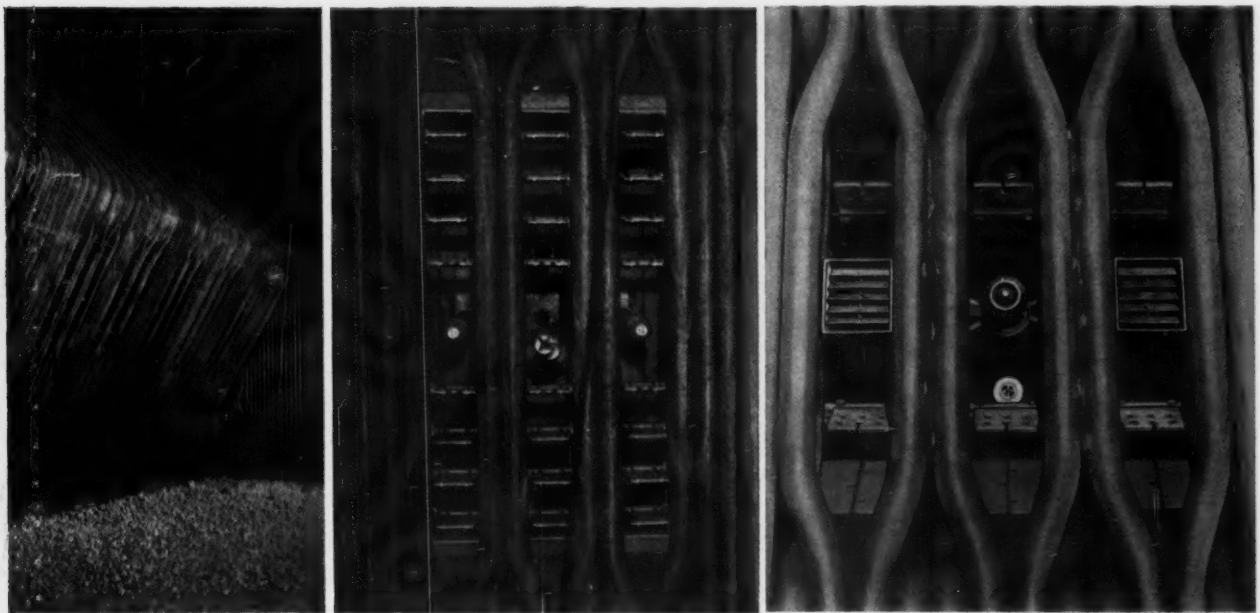
Riley Gas-Electric Ignitors are available with Riley Directional Flame Burners.

### Pressurized and Non-Pressurized Operation

Riley Directional Flame Burners are designed so that they can be used either with pressurized or non-pressurized furnaces.

For the complete description of the Riley TURBO FURNACE write:

RILEY STOKER CORPORATION, Worcester, Mass.



gas guns, gas electric ignitor, observation port. Burner can easily be converted to oil and coal firing. At far right is a Directional Flame Turbo Furnace Burner for firing coal, oil, and gas. Note the complete absence of burner refractory.

**SALES OFFICES**

Boston, Charlotte, Chicago, Cincinnati, Cleveland, Denver, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, St. Louis, St. Paul, Seattle, Syracuse.

**RILEY**

**STEAM GENERATING & FUEL BURNING EQUIPMENT**

# Power's data sheet

No. 350

## Alloy-steel pipe to ASTM Spec A-335 Grade P-11 (1¼% Cr–½% moly)

| Pipe size, in. | Nom OD, in. | Wall thick, in. | Temperature, F: To 800 | 850 | 900 | 950 | 1000 | 1050 |
|---|---|---|---|---|---|---|---|---|
| | | | Maximum allowable stress, psi: 15,000 | 14,400 | 13,100 | 11,000 | 7800 | 5500 |
| **Schedule 10** | | | | | | | | |
| 14 | 14 | .250 | 475 | 456 | 415 | 350 | 249 | 176 |
| 16 | 16 | .250 | 415 | 399 | 363 | 305 | 218 | 154 |
| 18 | 18 | .250 | 369 | 354 | 322 | 271 | 193 | 136 |
| 20 | 20 | .250 | 331 | 318 | 289 | 244 | 173 | 122 |
| 24 | 24 | .250 | 276 | 265 | 241 | 203 | 144 | 102 |
| **Schedule 20** | | | | | | | | |
| 8 | 8.625 | .250 | 777 | 746 | 679 | 573 | 411 | 290 |
| 10 | 10.75 | .250 | 621 | 596 | 543 | 458 | 327 | 231 |
| 12 | 12.75 | .250 | 522 | 502 | 456 | 384 | 275 | 194 |
| 14 | 14 | .312 | 594 | 571 | 519 | 438 | 313 | 221 |
| 16 | 16 | .312 | 519 | 498 | 453 | 382 | 273 | 192 |
| 18 | 18 | .312 | 461 | 442 | 402 | 339 | 242 | 170 |
| 20 | 20 | .375 | 499 | 479 | 435 | 367 | 262 | 185 |
| 24 | 24 | .375 | 415 | 398 | 362 | 305 | 217 | 153 |
| **Schedule 30** | | | | | | | | |
| 8 | 8.625 | .277 | 861 | 827 | 752 | 635 | 456 | 321 |
| 10 | 10.75 | .307 | 766 | 735 | 669 | 565 | 405 | 285 |
| 12 | 12.75 | .330 | 693 | 665 | 605 | 510 | 365 | 258 |
| 14 | 14 | .375 | 716 | 688 | 626 | 528 | 378 | 266 |
| 16 | 16 | .375 | 625 | 600 | 546 | 460 | 329 | 232 |
| 18 | 18 | .438 | 649 | 623 | 567 | 478 | 342 | 241 |
| 20 | 20 | .500 | 669 | 642 | 584 | 493 | 352 | 249 |
| 24 | 24 | .562 | 625 | 600 | 546 | 460 | 329 | 232 |
| **Schedule 40** | | | | | | | | |
| ⅛ | .84 | .109 | 1103 | 1059 | 963 | 815 | 586 | 414 |
| ¼ | 1.05 | .113 | 997 | 957 | 871 | 736 | 529 | 373 |
| ⅜ | 1.315 | .133 | 1200 | 1152 | 1048 | 887 | 639 | 451 |
| 1¼ | 1.66 | .14 | 1078 | 1035 | 942 | 797 | 573 | 404 |
| 1½ | 1.90 | .145 | 1005 | 965 | 878 | 742 | 533 | 376 |
| 2 | 2.375 | .154 | 905 | 869 | 791 | 668 | 479 | 338 |
| 2½ | 2.875 | .203 | 1217 | 1168 | 1063 | 900 | 649 | 457 |
| 3 | 3.50 | .216 | 1094 | 1050 | 955 | 808 | 582 | 410 |
| 4 | 4.50 | .237 | 1433 | 1375 | 1251 | 1061 | 767 | 541 |
| 5 | 5.563 | .258 | 1259 | 1209 | 1100 | 931 | 672 | 474 |
| 6 | 6.625 | .28 | 1143 | 1097 | 998 | 845 | 608 | 429 |
| 8 | 8.625 | .322 | 1007 | 967 | 880 | 744 | 534 | 377 |
| 10 | 10.75 | .365 | 912 | 875 | 796 | 673 | 483 | 341 |
| 12 | 12.75 | .406 | 854 | 820 | 746 | 630 | 452 | 319 |
| 14 | 14 | .438 | 839 | 806 | 733 | 619 | 444 | 313 |
| 16 | 16 | .50 | 840 | 806 | 733 | 619 | 444 | 313 |
| 18 | 18 | .562 | 838 | 805 | 732 | 618 | 443 | 313 |
| 20 | 20 | .593 | 797 | 765 | 696 | 587 | 421 | 297 |
| 24 | 24 | .687 | 768 | 737 | 671 | 566 | 406 | 286 |
| **Schedule 60** | | | | | | | | |
| 8 | 8.625 | .406 | 1277 | 1226 | 1115 | 944 | 681 | 480 |
| 10 | 10.75 | .50 | 1263 | 1213 | 1103 | 934 | 674 | 475 |
| 12 | 12.75 | .562 | 1195 | 1147 | 1043 | 883 | 636 | 449 |
| 14 | 14 | .593 | 1148 | 1102 | 1003 | 849 | 611 | 431 |
| 16 | 16 | .656 | 1108 | 1064 | 968 | 819 | 589 | 416 |
| 18 | 18 | .750 | 1126 | 1081 | 983 | 832 | 599 | 422 |
| 20 | 20 | .812 | 1098 | 1054 | 959 | 811 | 584 | 412 |
| 24 | 24 | .968 | 1091 | 1047 | 953 | 806 | 580 | 409 |
| **Schedule 80** | | | | | | | | |
| ⅛ | .84 | .147 | 2434 | 2337 | 2126 | 1814 | 1330 | 938 |
| ¼ | 1.05 | .154 | 2113 | 2028 | 1845 | 1571 | 1147 | 809 |
| ⅜ | 1.315 | .179 | 2222 | 2133 | 1940 | 1654 | 1209 | 852 |
| 1¼ | 1.66 | .191 | 1939 | 1861 | 1693 | 1440 | 1049 | 740 |
| 1½ | 1.90 | .20 | 1821 | 1748 | 1591 | 1352 | 983 | 693 |
| 2 | 2.375 | .218 | 1661 | 1595 | 1451 | 1232 | 894 | 630 |
| 2½ | 2.875 | .276 | 1942 | 1864 | 1696 | 1443 | 1051 | 741 |
| 3 | 3.50 | .30 | 1778 | 1707 | 1553 | 1319 | 958 | 676 |
| 4 | 4.50 | .337 | 2076 | 1993 | 1813 | 1543 | 1126 | 794 |
| 5 | 5.563 | .375 | 1856 | 1782 | 1621 | 1378 | 1002 | 707 |
| 6 | 6.625 | .432 | 1793 | 1721 | 1566 | 1331 | 967 | 682 |
| 8 | 8.625 | .50 | 1588 | 1524 | 1387 | 1177 | 853 | 601 |
| 10 | 10.75 | .593 | 1510 | 1449 | 1318 | 1118 | 809 | 571 |
| 12 | 12.75 | .687 | 1472 | 1413 | 1286 | 1090 | 789 | 556 |
| 14 | 14 | .75 | 1460 | 1402 | 1275 | 1082 | 782 | 552 |
| 16 | 16 | .843 | 1439 | 1381 | 1257 | 1065 | 770 | 543 |
| 18 | 18 | .937 | 1420 | 1363 | 1240 | 1051 | 738 | 536 |
| 20 | 20 | 1.031 | 1404 | 1348 | 1226 | 1039 | 751 | 530 |
| 24 | 24 | 1.218 | 1383 | 1328 | 1208 | 1024 | 740 | 522 |

| Pipe size, in. | Nom. OD, in. | Wall thick, in. | Temperature, F: To 800 | 850 | 900 | 950 | 1000 | 1050 |
|---|---|---|---|---|---|---|---|---|
| | | | Maximum allowable stress, psi: 15,000 | 14,400 | 13,100 | 11,000 | 7800 | 5500 |
| **Schedule 100** | | | | | | | | |
| 8 | 8.625 | .593 | 1900 | 1824 | 1659 | 1411 | 1027 | 724 |
| 10 | 10.75 | .718 | 1842 | 1768 | 1608 | 1367 | 994 | 701 |
| 12 | 12.75 | .843 | 1823 | 1750 | 1592 | 1354 | 984 | 694 |
| 14 | 14 | .937 | 1846 | 1772 | 1612 | 1371 | 997 | 703 |
| 16 | 16 | 1.031 | 1771 | 1700 | 1547 | 1314 | 955 | 673 |
| 18 | 18 | 1.156 | 1766 | 1696 | 1542 | 1311 | 952 | 671 |
| 20 | 20 | 1.281 | 1760 | 1690 | 1537 | 1306 | 949 | 669 |
| 24 | 24 | 1.531 | 1753 | 1683 | 1531 | 1301 | 945 | 666 |
| **XX** | | | | | | | | |
| ½ | .84 | .294 | 8389 | 8054 | 7327 | 6517 | 5242 | 3696 |
| ¾ | 1.05 | .308 | 6941 | 6664 | 6062 | 5337 | 4191 | 2955 |
| 1 | 1.315 | .358 | 6658 | 6391 | 5814 | 5109 | 3994 | 2816 |
| 1¼ | 1.66 | .382 | 5585 | 5361 | 4877 | 4254 | 3269 | 2305 |
| 1½ | 1.90 | .400 | 5114 | 4910 | 4466 | 3883 | 2962 | 2089 |
| 2 | 2.375 | .436 | 4480 | 4301 | 3913 | 3387 | 2559 | 1804 |
| 2½ | 2.875 | .552 | 4934 | 4737 | 4309 | 3741 | 2847 | 2007 |
| 3 | 3.50 | .600 | 4407 | 4230 | 3848 | 3329 | 2513 | 1772 |
| 4 | 4.50 | .674 | 4394 | 4218 | 3837 | 3319 | 2505 | 1766 |
| 5 | 5.563 | .750 | 3905 | 3749 | 3411 | 2940 | 2203 | 1553 |
| 6 | 6.625 | .864 | 3767 | 3616 | 3290 | 2834 | 2118 | 1494 |
| 8 | 8.625 | .875 | 2868 | 2753 | 2504 | 2144 | 1582 | 1115 |
| **Schedule 120** | | | | | | | | |
| 4 | 4.50 | .438 | 2740 | 2630 | 2393 | 2047 | 1507 | 1063 |
| 5 | 5.563 | .50 | 2520 | 2419 | 2201 | 1880 | 1380 | 973 |
| 6 | 6.625 | .562 | 2368 | 2273 | 2068 | 1765 | 1293 | 912 |
| 8 | 8.625 | .718 | 2323 | 2230 | 2029 | 1730 | 1267 | 893 |
| 10 | 10.75 | .843 | 2182 | 2095 | 1906 | 1624 | 1187 | 837 |
| 12 | 12.75 | 1.00 | 2178 | 2091 | 1902 | 1621 | 1184 | 835 |
| 14 | 14 | 1.093 | 2169 | 2082 | 1894 | 1614 | 1179 | 831 |
| 16 | 16 | 1.218 | 2113 | 2029 | 1846 | 1572 | 1147 | 809 |
| 18 | 18 | 1.375 | 2118 | 2034 | 1856 | 1576 | 1150 | 811 |
| 20 | 20 | 1.50 | 2079 | 1996 | 1815 | 1546 | 1128 | 795 |
| 24 | 24 | 1.812 | 2093 | 2009 | 1828 | 1557 | 1136 | 801 |
| **Schedule 140** | | | | | | | | |
| 8 | 8.625 | .812 | 2647 | 2541 | 2312 | 1976 | 1454 | 1025 |
| 10 | 10.75 | 1.00 | 2612 | 2507 | 2281 | 1949 | 1433 | 1010 |
| 12 | 12.75 | 1.125 | 2468 | 2369 | 2155 | 1840 | 1350 | 952 |
| 14 | 14 | 1.25 | 2500 | 2400 | 2184 | 1865 | 1369 | 965 |
| 16 | 16 | 1.438 | 2517 | 2417 | 2198 | 1877 | 1378 | 972 |
| 18 | 18 | 1.562 | 2426 | 2329 | 2118 | 1808 | 1326 | 935 |
| 20 | 20 | 1.75 | 2446 | 2348 | 2136 | 1824 | 1337 | 943 |
| 24 | 24 | 2.062 | 2399 | 2303 | 2095 | 1788 | 1310 | 924 |
| **Schedule 160** | | | | | | | | |
| ⅛ | .84 | .187 | 3947 | 3789 | 3447 | 2973 | 2229 | 1571 |
| ¼ | 1.05 | .218 | 4017 | 3856 | 3508 | 3027 | 2271 | 1602 |
| ⅜ | 1.315 | .25 | 3873 | 3718 | 3382 | 2915 | 2183 | 1539 |
| 1¼ | 1.66 | .25 | 3006 | 2886 | 2625 | 2249 | 1663 | 1173 |
| 1½ | 1.90 | .281 | 3093 | 2970 | 2702 | 2316 | 1715 | 1209 |
| 2 | 2.375 | .343 | 3237 | 3107 | 2827 | 2426 | 1800 | 1269 |
| 2½ | 2.875 | .375 | 2960 | 2841 | 2585 | 2214 | 1636 | 1154 |
| 3 | 3.50 | .438 | 2939 | 2822 | 2567 | 2199 | 1624 | 1145 |
| 4 | 4.50 | .531 | 3379 | 3244 | 2951 | 2535 | 1885 | 1329 |
| 5 | 5.563 | .615 | 3201 | 3073 | 2796 | 2399 | 1778 | 1254 |
| 6 | 6.625 | .718 | 3082 | 2959 | 2692 | 2308 | 1708 | 1204 |
| 8 | 8.625 | .906 | 2977 | 2858 | 2600 | 2227 | 1646 | 1161 |
| 10 | 10.75 | 1.125 | 2963 | 2845 | 2588 | 2217 | 1638 | 1155 |
| 12 | 12.75 | 1.312 | 2911 | 2794 | 2542 | 2177 | 1607 | 1133 |
| 14 | 14 | 1.406 | 2835 | 2722 | 2476 | 2119 | 1563 | 1102 |
| 16 | 16 | 1.593 | 2812 | 2699 | 2455 | 2101 | 1549 | 1092 |
| 18 | 18 | 1.781 | 2790 | 2678 | 2436 | 2085 | 1536 | 1083 |
| 20 | 20 | 1.968 | 2776 | 2665 | 2424 | 2074 | 1528 | 1078 |
| 24 | 24 | 2.343 | 2752 | 2642 | 2403 | 2056 | 1514 | 1068 |

## Maximum allowable working pressure–5

Figures in table are maximum pressures, psi, for given temperatures and stresses. See June *Data Sheet 346* for basic formula used to calculate the table.

GEORGE C HALZELL, *Boston, Mass.*

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# "Made OF Stainless Steel ...Made BY Jenkins"

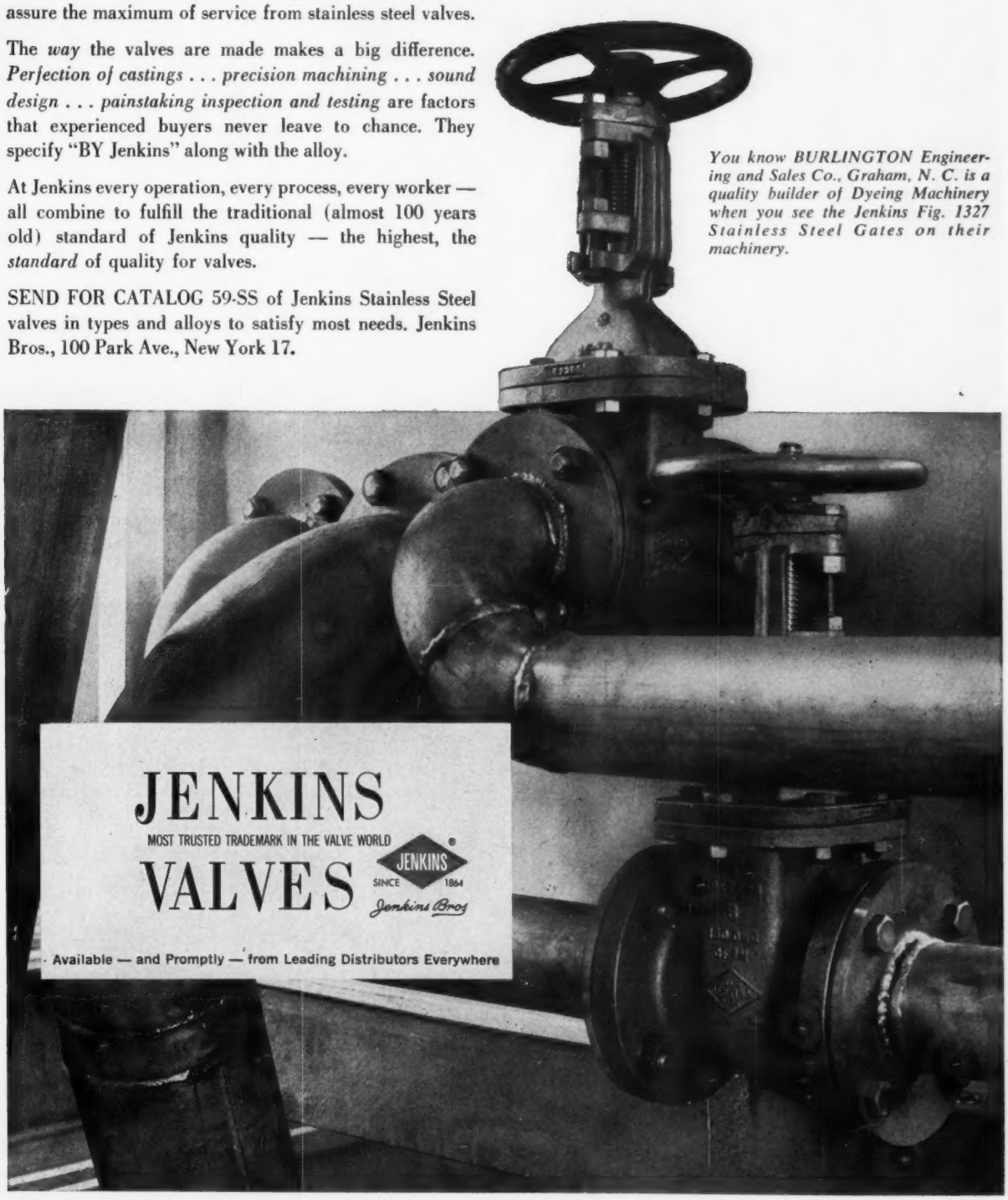
## Write the COMPLETE SPEC for an extra-measure of service

Of course the metal, the alloy, is important when applications require stainless steel valves. But the specification for a suitable alloy is only half the specification needed to assure the maximum of service from stainless steel valves.

The *way* the valves are made makes a big difference. *Perfection of castings . . . precision machining . . . sound design . . . painstaking inspection and testing* are factors that experienced buyers never leave to chance. They specify "BY Jenkins" along with the alloy.

At Jenkins every operation, every process, every worker — all combine to fulfill the traditional (almost 100 years old) standard of Jenkins quality — the highest, the *standard* of quality for valves.

SEND FOR CATALOG 59-SS of Jenkins Stainless Steel valves in types and alloys to satisfy most needs. Jenkins Bros., 100 Park Ave., New York 17.




*You know BURLINGTON Engineering and Sales Co., Graham, N. C. is a quality builder of Dyeing Machinery when you see the Jenkins Fig. 1327 Stainless Steel Gates on their machinery.*



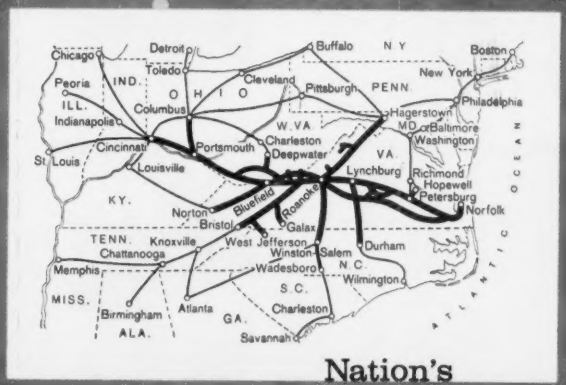
For more facts circle 827 on Reader Service card, p 197

# Pick your

Custom-blended coals to meet exact specifications . . . that's what overseas and coastwise shippers get at N&W piers in Norfolk. 507 separate coal classifications are on N&W books. Moreover, valuable time is saved by consolidation of former Virginian Railway coal-loading facilities with those of the N&W at Lambert's Point. Ships don't have to move from pier to pier to get the required blend.

Wide choice of blends is just one reason for the selection of the N&W and Norfolk for exporting and shipping coal coastwise. In addition, the N&W is now building a second 1,000 king-size, 85-ton coal hoppers which carry bigger payloads and speed shiploading. Also, transit time from mines to Tidewater has been cut by as much as a full day. And N&W will build a great new coal pier . . . the world's fastest-loading and most modern — with special facilities for handling the huge new 35,000 — 50,000 ton colliers.

For the exact blend, dependable transportation, and fast, complete shiploading facilities, it pays to ship coal through Norfolk . . . the port that's served by the N&W, one of the nation's major originators of coal.




Nation's
Going-est
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N&W

NORFOLK and WESTERN
RAILWAY
GENERAL OFFICES • ROANOKE, VA.

# SOLVE THESE NINE KEY WATER HANDLING PROBLEMS IN YOUR POWER PLANT WITH PEERLESS PUMPS

***apply these proven-in-use pumps to cover a broad range of services in circulating, boosting, draining and transfer applications...***

Producing power calls for equipment that can meet the rigors of continuous day-in, day-out performance. It calls for top performing pumps teamed with maximum engineering stamina.

It's a standard that Peerless meets and beats with ease. Small wonder then that Peerless equipment is selected in job after job. But Peerless offers you another added plus—careful, conscientious field engineering service. It's there when you want it, and it is there to help you in planning the best practical methods for handling the various pumping jobs you have. Here's another point to consider. The Peerless line is a complete one. Select your needs from pumps ranging from small fractional horsepower models to giant units capable of moving up to 220,000 gpm. Check the pumps listed below and request your copies of the bulletin you wish sent to you. Write Peerless Pump, Hydrodynamics Division, Food Machinery and Chemical Corporation at 301 West Avenue 26, Los Angeles 31, California, or 2005 Northwestern Avenue, Indianapolis 8, Indiana.

*Putting Ideas to Work*

**PEERLESS PUMP**
HYDRODYNAMICS DIVISION

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*Offices:* New York; Detroit; Chicago; Cleveland; Indianapolis; St. Louis; San Francisco; Atlanta; Plainview; Lubbock; Phoenix; Albuquerque; Los Angeles; Fresno.

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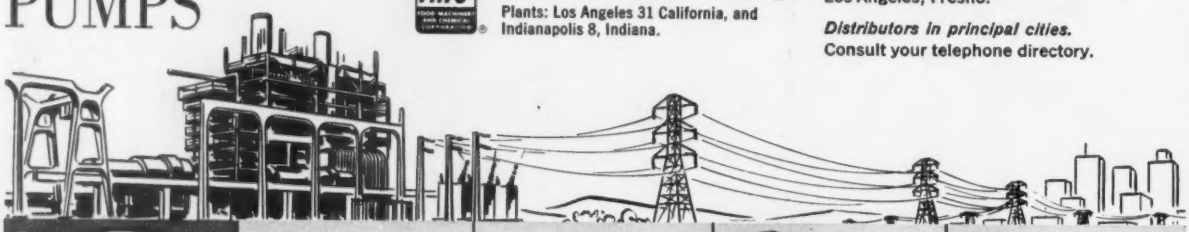

PEERLESS PUMP

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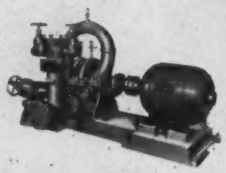
**BOOSTER, CIRCULATING SERVICE**
Horizontal Split Case Peerless TYPE A offers widest possible application in water pumping. Broad range of capacities and heads. Request Bulletin B-1300.



**FIRE PREVENTION AND CONTROL**
Select from vertical and horizontal FIRE PUMP models. All models are approved by Underwriters Lab and Associated Factory Mutual Fire Insurance Companies. Request Bulletin B-1500.

**CONDENSER CIRCULATING SERVICE**
Close Coupled HYDRO-FOIL pumps can be installed for wet or dry pit application. Extremely adaptable where space is limited. Request Bulletin B-148.

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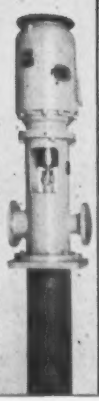
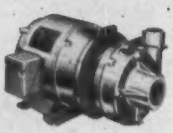
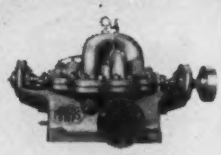
The Peerless line of VERTICAL INDUSTRIAL SERVICE pumps are extremely efficient, require little maintenance. Install them inside or outside. Request Bulletin B-505.



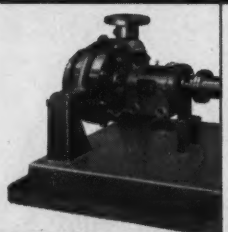
**HEATER DRAIN, CONDENSATE RETURN SERVICE**
Peerless HYDRO-LINE® pumps handle fluids up to 400°F. Will operate with any available NPSH. Request Bulletin B-1700.



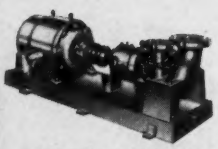
**IN-PLANT CHILLED WATER PUMPS**
End suction centrifugal FLUIDYNE® pumps are highly versatile in application, extremely efficient in service, and economical to operate. Models in all desired sizes. Request Bulletin B-2300.



**EVAPORATOR FEED, BOILER WASH, HEATER DRAIN**
Peerless TU and TUT pumps have internal or loop cross-over, Multi-stage design allow pumps to develop high head and capacity from a compact unit. Request Bulletin B-1400.



**HOT WATER, TRANSFER CHEMICAL FEED**
Select from a comprehensive line of Peerless TYPE DM AND DMR pumps. Unsurpassed for handling superheated water and chemical fluids. Request Bulletins B-1608, B-1610.



**BOILER LANCERS, HEATER DRAIN**
A heavy duty, packing gland type pump, the Peerless TYPE PR is specially designed for heavy pumping assignments. Handles hot or cold liquids with equal efficiency. Request Bulletin B-1605.

YARWAY news briefs

*from* **Yarnall-Waring Company,** *Philadelphia 18, Pa.*

*BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD*

# IF DEPENDABILITY IS WHAT YOU WANT... GET UNIT TANDEM BLOW-OFF VALVES

New Yarway Unit Tandem Blow-Off Valves for boiler pressures to 515 lbs. wsp* "have what it takes" to give you the dependable protection your boiler investment deserves.

## RUGGED, COMPACT DESIGN

Unique design and strong construction combines blowing and sealing valves in a common "unit" body of forged steel block—extra *protection*, extra *dependability*.

## DEPENDABLE PERFORMANCE

Design, materials, workmanship add up to *trouble-free performance*. Seatless (sealing) valves are famous Yarway balanced sliding plunger type. Hard-seat (blowing) valves are Yarway welded-bonnet type, with deep stellite seat and disc, non-pitting stainless steel valve stem and special inhibited packing.

## EASY MAINTENANCE

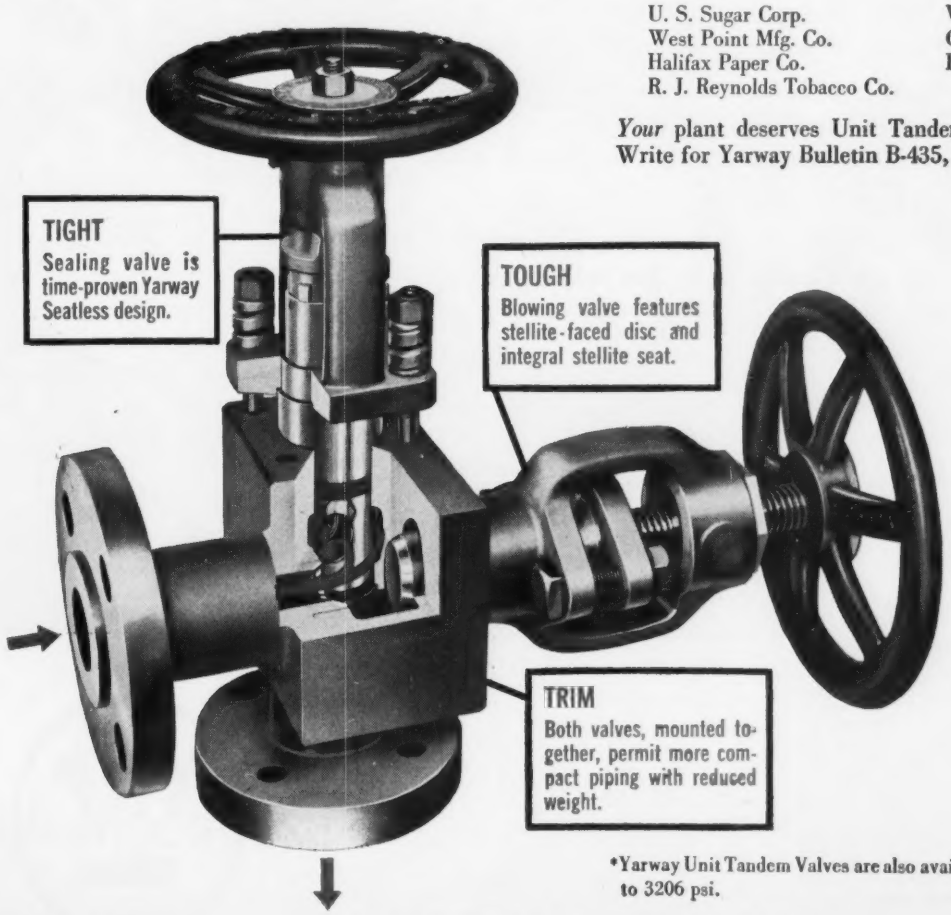
Working parts are easily accessible. Special reseating tool permits actual reseating of hard-seat valve with *valve in the line.*

## PROVED ACCEPTANCE

Among hundreds, here are just a few satisfied users of this Yarway valve:

U. S. Sugar Corp.
West Point Mfg. Co.
Halifax Paper Co.
R. J. Reynolds Tobacco Co.
Western Electric Co.
Cornell University
Pulp and Paper Co. of Colombia, S.A.

*Your* plant deserves Unit Tandem dependability, too. Write for Yarway Bulletin B-435, Supplement A.

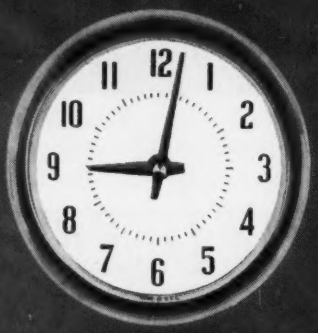

TIGHT
Sealing valve is time-proven Yarway Seatless design.
TOUGH
Blowing valve features stellite-faced disc and integral stellite seat.
TRIM
Both valves, mounted together, permit more compact piping with reduced weight.

*Yarway Unit Tandem Valves are also available for higher pressures to 3206 psi.



For more facts circle 830 on Reader Service card, p 197

# Westinghouse F/A motor completely disassembled in 90 minutes



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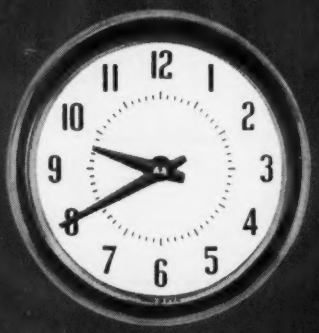
Only 90 minutes are required to completely disassemble the Westinghouse F/A (fully accessible) motor. After cleaning, inspecting and servicing, the F/A motor can be completely reassembled and returned to service in about two hours. One maintenance engineer reports that an F/A motor is serviced in his shop in about one-fourth the normal time for comparably rated motors. F/A motors are available in ratings from 250 hp/600 rpm to 7000 hp/3600 rpm. For more information, call your Westinghouse representative. Or, write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. *You can be sure . . . if it's Westinghouse.*



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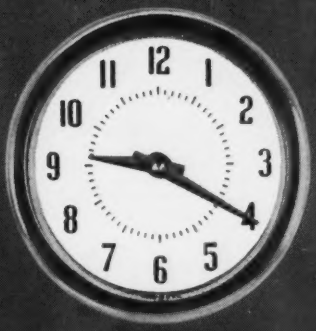
For more facts circle 831 on Reader Service card, p 197

Motor stopped; disassembly begun.



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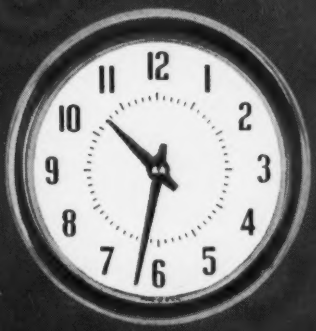
End covers, side panels, air shields removed. Winding inspection now possible.

Sufficiently disassembled to permit bearing inspection.



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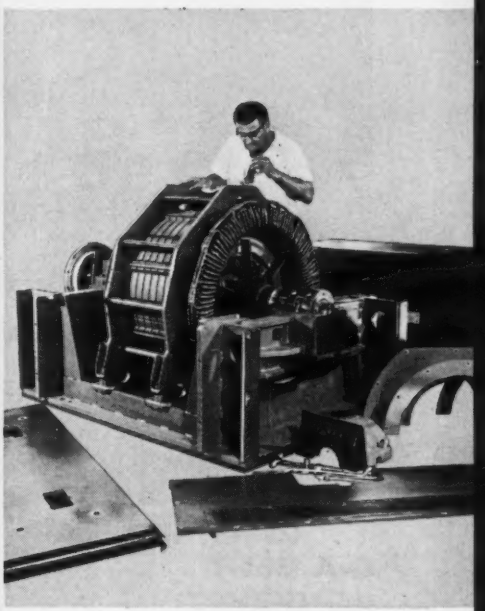


Complete disassembly possible for major cleaning, inspection and servicing.

4-15023

Westinghouse

...and reassembled in just two hours

# STEPHENS-ADAMSON

## BELT CONVEYOR SYSTEMS

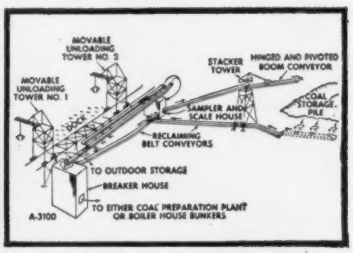
provide maximum efficiency in converting coal to kilowatts

Maximum efficiency in converting coal to kilowatts is attained through the use of STEPHENS-ADAMSON Belt Conveyor Systems. Unloading, storing, crushing, reclaiming, sampling and distribution functions are all accomplished by S-A Belt Conveyor Systems. Coal moves to any desired point in a continuous, uninterrupted flow. Tonnage handled is increased while handling costs are cut to the lowest cost per ton. Quality Belt Conveyor System components backed by 60 years of bulk handling experience assure minimum "downtime," minimum maintenance and years of dependable service. Write for full details today.

**S-A BELT CONVEYOR SYSTEMS HANDLE COAL AT LOWEST COST PER TON!**

STORAGE—S-A Belt Conveyor Stacker handles storage pile operation

RECLAIMING—S-A Belt Conveyors move coal from storage to bunkers




Typical power plant, coal handling, belt conveyor system.

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ENGINEERED BULK HANDLING SYSTEMS
MATERIALS HANDLING PRODUCTS
SPEEDWALK® PASSENGER CONVEYORS
SEALMASTER BALL BEARING UNITS
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For more facts circle 832 on Reader Service card, p 197

# Armaflex sheets . . . the better, faster way to insulate large pipes, tanks and vessels

Armaflex sheets are great time-savers in the insulation of large pipes, tanks and vessels from sub-zero to 160F temperatures. Other insulations often require mechanical support, cement or mastic coatings, and expensive vapor-proof finishing. Armaflex sheets do away with these time-consuming steps. The 30″ x 36″ sheets need only be cut to fit, where necessary, and cemented in place with Armstrong 520 Adhesive. Their foamed plastic composition is an excellent vapor barrier, assuring long service, and their flexibility allows fast and efficient workmanship.

Armaflex sheets are part of a complete line of Armaflex products that includes flexible Armaflex 22 Pipe Covering, Rigid Armaflex for use where compression of insulation is a problem, and Armaflex Finish and Adhesives. For full product information and detailed specifications on all these Armaflex materials together with complete application instructions, write today to Armstrong Cork Company, 2210 Riggs Avenue, Lancaster, Pennsylvania.

ARMAFLEX ® IS A TRADE-MARK OF ARMSTRONG CORK COMPANY

**Armstrong INSULATIONS**

ARMAFLEX 22 • RIGID ARMAFLEX • ARMAFLEX SHEETS • ARMAFLEX FINISH • ARMAFLEX ADHESIVES

For more facts circle 833 on Reader Service card, p 197

**Corrosion on the Run** . . . Cascading over a waterfall or tumbling from the sky, tiny droplets of water absorb gases from the atmosphere. While aerated water is pleasant to the taste and touch, it vigorously corrodes and destroys boiler tubes, industrial piping systems and processing equipment. Effective deaeration is the best answer to the removal of destructive gases such as oxygen and carbon dioxide. ● Over 75 years ago, Cochrane pioneered the first of many developments in this field with the introduction of the direct contact feedwater heater. Today, with the largest number of deaerator installations in the world, Cochrane continues to research and refine this important requirement of modern power and processing plants. This background is your assurance of proper recommendation and performance. In water conditioning . . . the name is Cochrane. Ask for literature on applications and types of deaerators. Write Cochrane Division, Crane Co. 3106 N. 17th Street. Philadelphia 32, Penna.

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COCHRANE DIVISION **CRANE** WATER CONDITIONING

*plumbing*
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For more facts circle 834 on Reader Service card, p 197

## This is Where the Power is Built into

# NORDBERG DIESEL ENGINES

Thirty years of research and development experience in the heavy machinery field were focused on the design and manufacture of internal combustion engines when, in 1915, Nordberg became the first American manufacturer of large, heavy duty diesels.

From this unique and specialized engine building experience, there have evolved many exclusive engineering achievements. Today, Nordberg builds the largest line of heavy duty diesel engines in the western hemisphere . . . in sizes from 10 to over 12,000 horsepower in a single engine.

**NORDBERG MANUFACTURING COMPANY**
**Milwaukee 1, Wisconsin**

NORDBERG MACHINERY

ATLANTA • CLEVELAND • DALLAS • DULUTH • HOUSTON • KANSAS CITY • MINNEAPOLIS
NEW ORLEANS • NEW YORK • PHOENIX • ST. LOUIS • SAN FRANCISCO • TAMPA • WASHINGTON
WICHITA, KANS. • TORONTO • VANCOUVER • JOHANNESBURG • LONDON • MEXICO, D. F.

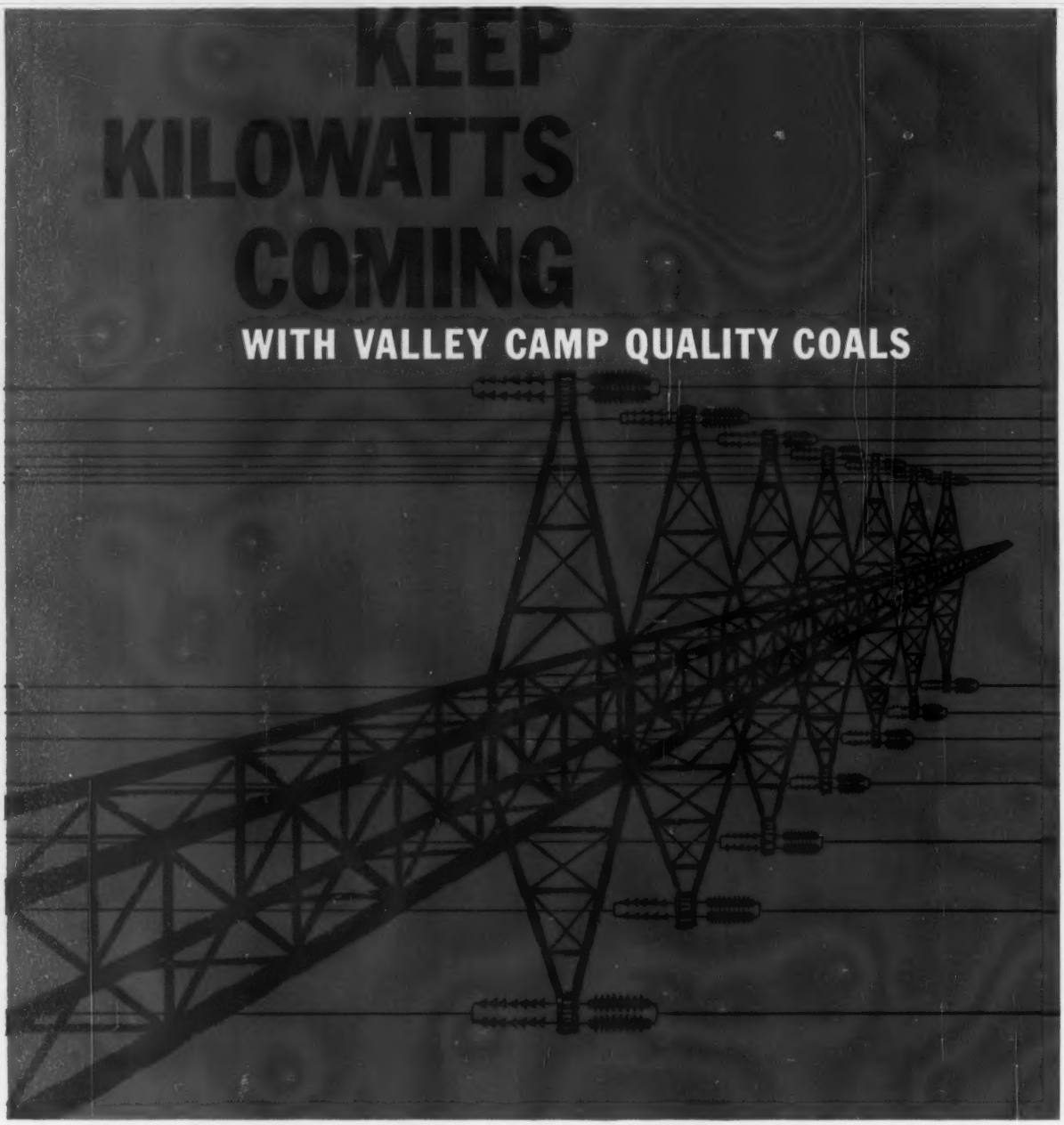
1886-1961 75th ANNIVERSARY

© 1961, N.M.CO.

P361-R



For more facts circle 835 on Reader Service card, p 197




Our entire coal service is directed toward the mining and thorough preparation of Quality Coals best suited for steam plants generating electrical energy.

You can Keep Kilowatts Coming with Valley Camp Quality Coals . . . our combustion engineering service will be pleased to show you how.

# THE VALLEY CAMP COAL COMPANY

**Western Reserve Building • Cleveland 13, Ohio**

*SUBSIDIARIES —*
Great Lakes Coal & Dock Co., Milwaukee, Wis. • Great Lakes Coal & Dock Co., St. Paul, Minn. • Fort William Coal Dock Co., Ltd., Fort William, Ont. • The Valley Camp Coal Co. of Canada Ltd., Toronto, Ont. • Kelley's Creek & Northwestern Railroad Co. • Kelley's Creek Barge Line Inc. • Pennsylvania & West Virginia Supply Corp.

*SALES OFFICES —*
Philadelphia • Baltimore • Buffalo • Pittsburgh • Wheeling • Cleveland • St. Paul • Cincinnati • New York • Milwaukee • Superior, Wis. • Fort William, Ont. • Toronto, Ont.



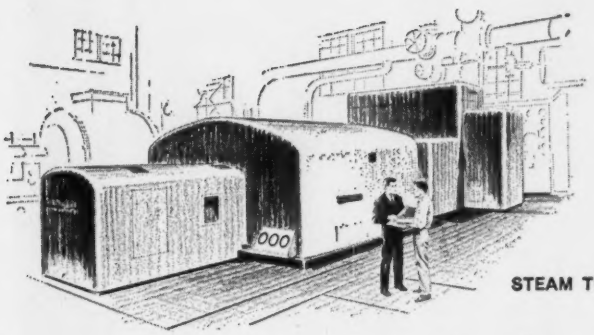
For more facts circle 836 on Reader Service card, p 197

# DE LAVAL

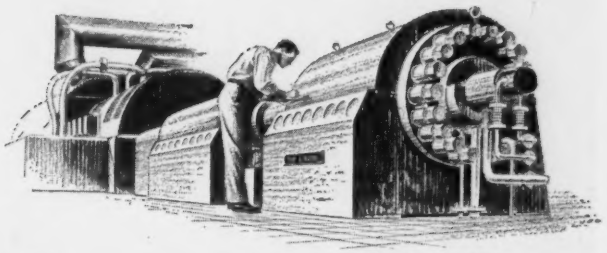
## engineered dependability has helped keep America strong for 60 years

Since 1901, De Laval has helped keep America strong by supplying high-quality, precision-built equipment to almost every industry and service. In refineries . . . power plants . . . steel mills . . . mines . . . waterworks . . . pipelines . . . paper mills . . . the armed forces and the merchant marine, De Laval's engineered dependability has helped strengthen our country's economy and defenses for 60 years.

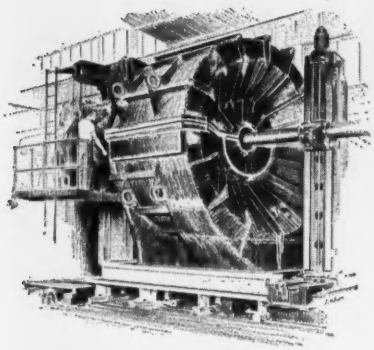
**De Laval Steam Turbine Company, Trenton 2, N. J.**



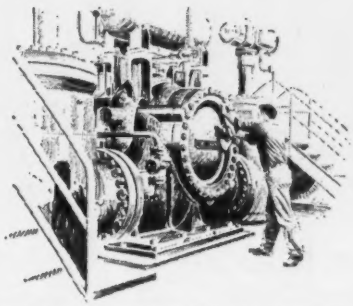
STEAM TURBINES



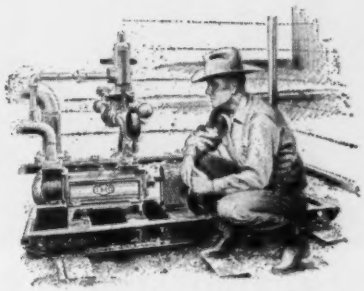
CENTRIFUGAL PUMPS



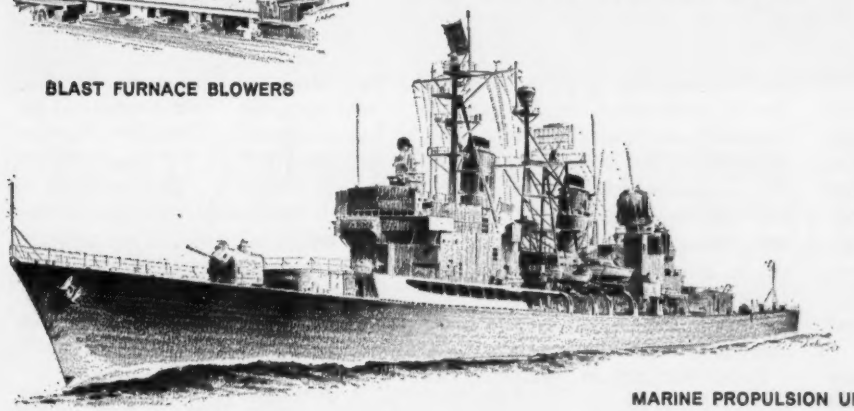
BLAST FURNACE BLOWERS

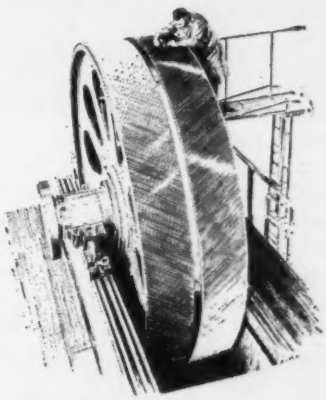


SINGLE- AND MULTI-STAGE COMPRESSORS



IMO® ROTARY PUMPS





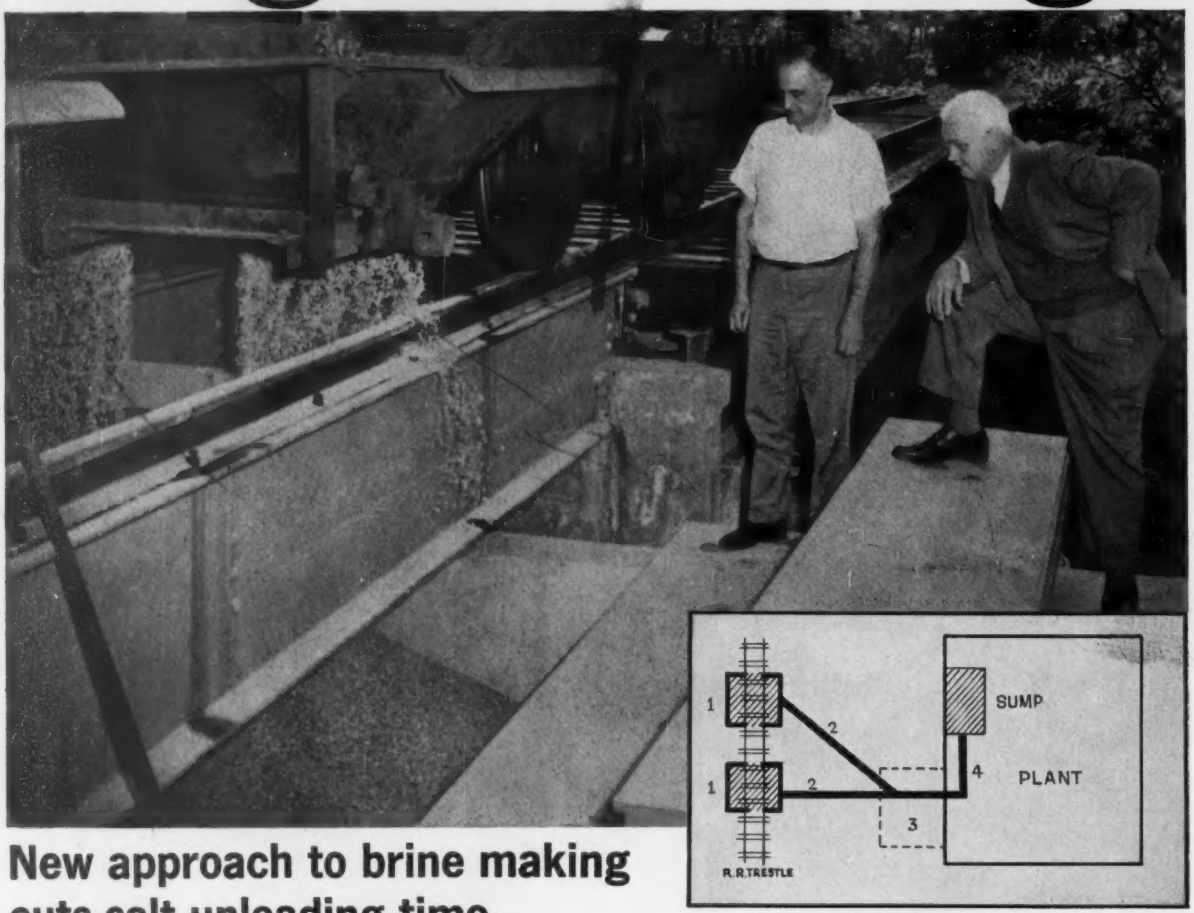
MARINE PROPULSION UNITS AND AUXILIARIES

MG-DL-113

# DE LAVAL · 60 YEARS OF CREATIVITY AND QUALITY

CENTRIFUGAL PUMPS AND COMPRESSORS • TURBINES • IMO® ROTARY PUMPS AND HYDRAULIC MOTORS
MARINE PROPULSION AND AUXILIARY EQUIPMENT • HELICAL AND EPICYCLIC GEARS • TURBOCHARGERS

# salt engineering




Pipes (2) deliver brine from new 55-ton Lixators (1) to existing pipe line (4) that served old Lixator (3). New construction made maximum use of existing installation—did not affect railroad trestle or plant interior.

## New approach to brine making cuts salt unloading time 32 man-hours per car

At this N. J. plant Sterling Rock Salt used to be unloaded manually into a chute feeding a brine tank located ten feet from the tracks. Cost of the operation: an expensive 32 man-hours per car. Furthermore, the 60-ton brine tank had to be exhausted down to ten tons before another 50-ton carload of salt could be added, creating problems of reserve and scheduling.

An International Salt Company Technical Service representative and the plant manager solved the situation by installing two 55-ton Sterling Storage Lixators under the existing railroad trestle. Salt drops directly from the hopper cars into them. Gravity supplies the labor, releasing the 32 man-hours. And when the Lixators* get down to 30 tons each, a 50-ton carload tops them off with 25 tons apiece. Ordering is simplified, and the buyer never has to worry about reserve. And how does the salt get to points of use? Simple. The Lixators produce crystal-clear, fully saturated brine *automatically*. Pipes carry it into the plant.

Local contractors competed for the job by sealed bids estimated from complete plans supervised by International's Technical Service Department.

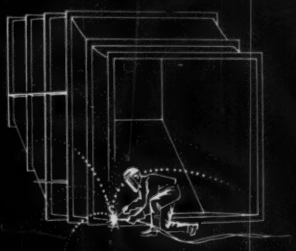
This project is a good example of how International salt engineering can benefit salt users. If you're interested in unequaled technical assistance on any phase of salt handling, storage or dissolving, write International Salt Company, Clarks Summit, Pa., or nearest district office.

*Registered T.M. International Salt Company

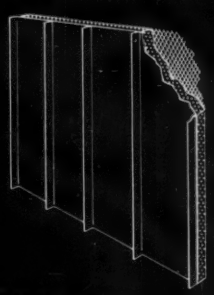
BOSTON CHARLOTTE CINCINNATI NEWARK NEW YORK PITTSBURGH
BUFFALO CHICAGO DETROIT NEW ORLEANS PHILADELPHIA ST. LOUIS

**INTERNATIONAL STERLING SALT SALT COMPANY**

"A STEP AHEAD IN SALT TECHNOLOGY"

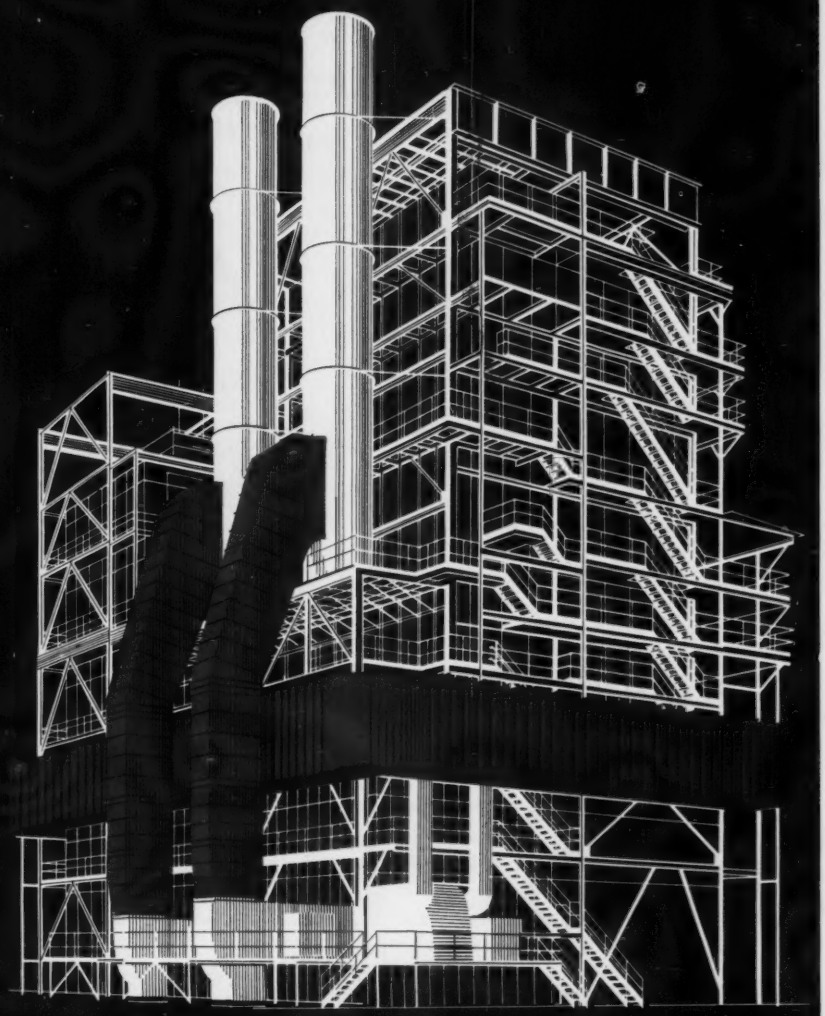


Breeching panels are factory prefabricated and/or pre-insulated; match-marked for shipment.



DeVilbiss combines insulation and lagging into a prefabricated panel, reducing insulation costs.

Experienced DeVilbiss crews are available to handle complete job-site assembly and erection.



**pre-insulated breeching** is a new concept pioneered by DeVilbiss' Metal Fabricators Division. It means prefabricating lagging and insulation in a single operation at the factory. Benefits to you: substantial reduction of field-insulation costs, reduced corrosion, increased thermal efficiency. Specialists work with you, from blueprint detailing to erection in your plant.

**Talk to DeVilbiss about all your power-plant breeching requirements**

FOR TOTAL SERVICE, CALL

**DEVILBISS**

*THE DeVILBISS COMPANY, Toledo 1, Ohio. Also Barrie, Ontario; London, England; São Paulo, Brazil. Branch offices in principal cities.*



For more facts circle 839 on Reader Service card, p 197

# accuracy

**ASHCROFT DURAGAUGES** measure pressure with precise accuracy no matter how severe the conditions of service

*Ashcroft Duragauges are available in pressure ranges from 15 psi (or vacuum) minimum to 100,000 psi. Dial sizes: 4½" through 12".*

# sustained

The Bourdon tube in Ashcroft Duragauges is manufactured to precision standards of flexibility and mono-linked to the rotary movement. When pressure flexes the tube, the gauge pointer is always positively positioned, because it is mounted on the geared center shaft of the movement. Sustained high accuracy and long life are assured.

Choose your Ashcroft Duragauges made of components best suited to your needs. Eight Bourdon tube materials are available. Movement of stainless steel with nylon bearings and pinion gear for longest wear. Case materials: special aluminum alloy or tough phenol plastic.

The unique "Maxisafe®" Duragauge provides absolute protection to the viewer, plus easy and quick access to the mechanism. Your industrial supply distributor will help you select the best combination of components for your Ashcroft Gauge requirements. Phone him today or write for Catalog 300B.

**ASHCROFT PRESSURE GAUGES**

*A product of*

**MANNING, MAXWELL & MOORE, INC.**

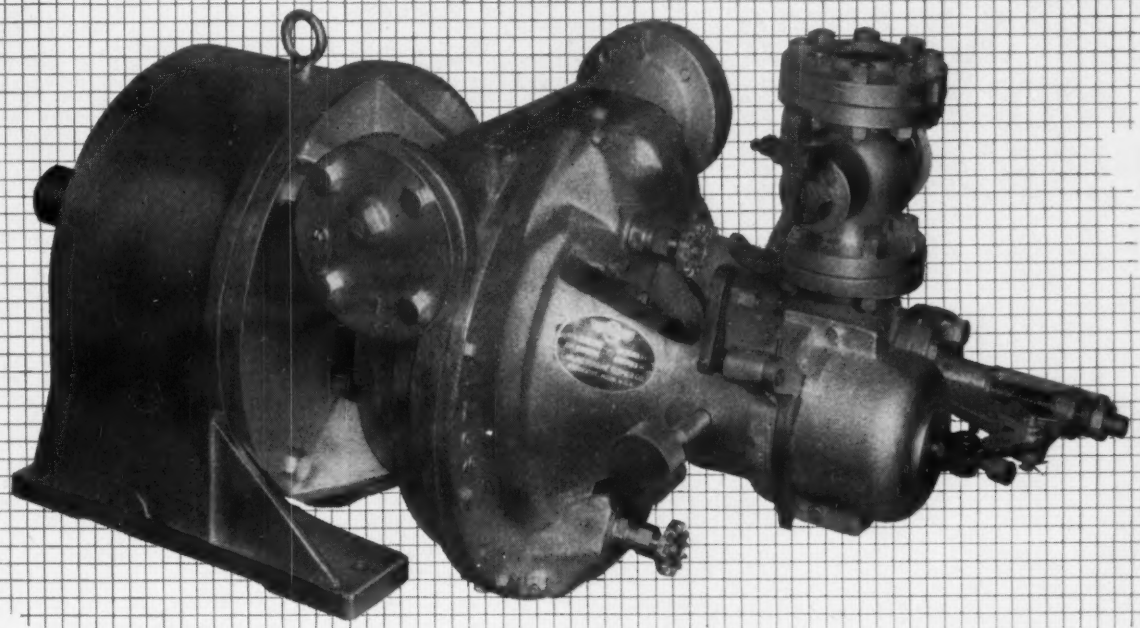
*Gauge and Instrument Division • Stratford, Connecticut*

*Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*
*Latin America: Export Division, Chrysler Building, New York, N. Y.*
*Europe: Manning, Maxwell & Moore, S. A., Fribourg, Switzerland*

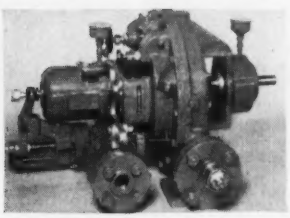


**For more facts circle 840 on Reader Service card, p 197**

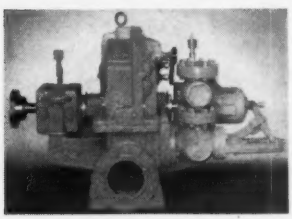
## What's new at CARLING?



# ... the New Carling Turbine Gear Combination with Safety Brake Rim Construction



On *all* Carling turbines, safety brake rim construction is standard; extra hand valves allow economical power control.



New, yet proven. In a wide range of carefully noted trial installations, the Carling Turbine Gear Combination has shown true economy while operating under many and varied conditions.

Here's why:

**ALIGNMENT PROBLEM ELIMINATED** The gear supports the turbine, so there's no worry about alignment on the high-speed input side.

**SAVES COSTS TOO** No couplings between turbine and gear means lower initial cost.

**WATER RATE IS LOWER** Turbines running at higher turbine rpm use less steam for the same amount of horsepower.

**EASY TO MAINTAIN** The turbine end can be disconnected without disturbing the gear end and upsetting delicate alignment.

**COMPLETE SIZE RANGE** There's economy, too, in selecting the proper size for the job. Carling offers *all* sizes — in single, double and triple reductions.

**ASK FOR BULLETIN 20-C-3**

Helpful engineering data and specs will simplify your selection of turbines for any job.

**CARLING TURBINE BLOWER CO.**
WORCESTER, MASSACHUSETTS

# IF YOU WANT SUPERIOR PRECIPITATOR PERFORMANCE

A precipitator is a lifetime purchase. Once it is installed, you must live with it, whether you like its habits or not. Because of that Buell urges you to look for the following features when you are making the major investment represented by an electric precipitator.

### CONSTRUCTION

**1. Custom designed, flexible**—Buell helps you determine your precipitator needs, then designs a unit specifically for your requirements. Since Buell SF Precipitator sizes change by only 16" increments, you can get exactly the size you need, without compromise of size, space, and cost.

**2. Simplified erection**—Modern construction and assembly-marked components and a design that facilitates simple installation, make Buell SF Precipitators easy to erect without specialized contractors. Erection is supervised by Buell engineers, to ensure satisfactory operation.

**3. Rugged construction**—Simple, rugged construction gives you high efficiency, combined with negligible maintenance costs.

### GAS FLOW

**4. Uniform gas distribution**—Buell designs the entire gas system for its precipitators—including connecting flues with adjustable turning vanes if needed. In addition, at the inlet, special field-adjusting baffles ensure uniform flow across the entire face of the unit. Buell has complete laboratory facilities to determine dust or gas flow pattern with specially constructed three dimensional precipitator models.

### ELECTRICAL SYSTEM

**5. Fool-proof power supply**—Buell silicon rectifiers are compact, lightweight, highly efficient. They need no maintenance—another reason for the top performance of a Buell SF Precipitator.

**6. Rigid suspension**—The emitting frame of a Buell SF Precipitator is hung from four temperature and shock resistant quartz insulators, each sealed in an individual heated compartment. With this rigid system, electrical distance from emitting to collecting electrode is held constant. This produces uniformly high emission for peak efficiency.

**7. Peak emission**—Exclusive Spiralectrode® emitting electrodes are fixed top and bottom to the emitting frame. Self-tensioned and permanently aligned, they present areas of maximum emission per unit of power input. Top emission can be maintained with maximum applied voltage, because Spiralectrodes eliminate misalignment.

**8. Minimum maintenance**—The common maintenance headache in most precipitators is frequent replacement of emitting electrodes. Because of rugged suspension and patented electrode design, Buell's 10-year replacement record in this critical area is under 2%.

### RAPPING

**9. Effective rapping—avoids reentrainment**—Buell mechanically raps one row of electrodes at a time, in a continuous cycle. Special pockets in collecting electrodes, and section-by-section rapping in the direction of gas flow, ensure against reentrainment.

You're sure to be pleased with the superior performance and minimum maintenance you'll get with a Buell SF Precipitator! Buell Engineering Co., Inc., Dept. 50-J, 123 William St., New York 38, N. Y. electric precipitators · cyclones · bag collectors · combination systems · classifiers. **Member Industrial Gas Cleaning Institute**

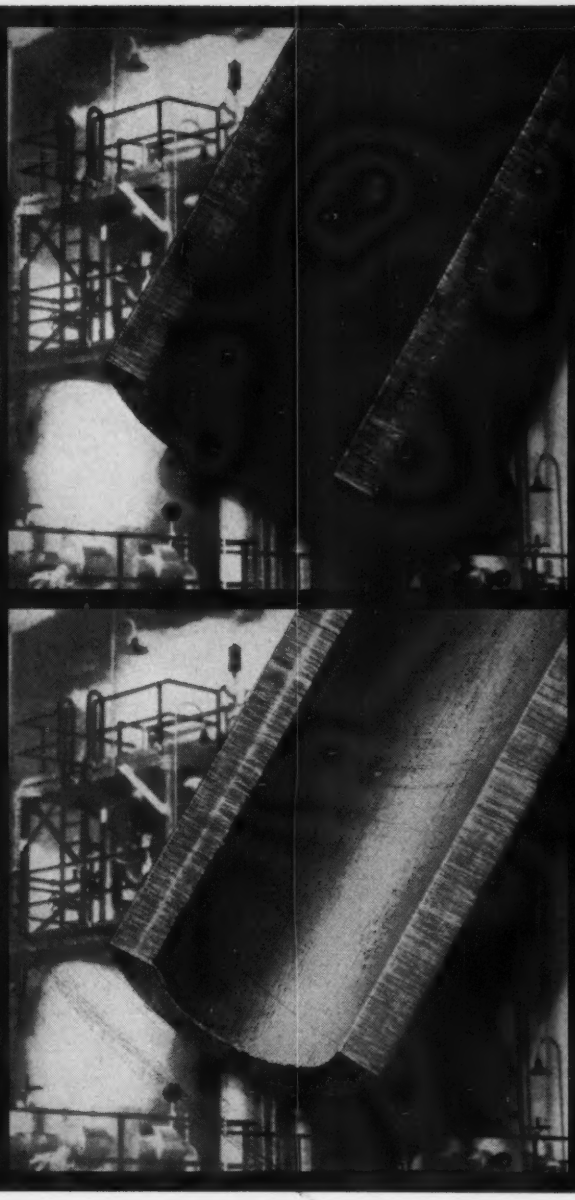
buell Norblo



For more facts circle 842 on Reader Service card, p 197

# BETTER OPERATIONAL CLEANING BEGINS...

## WITH THE NEW PFIZER CITRIC ACID PROCESS



These steel tube sections taken from a typical boiler system were "look alikes" until one was cleaned with ammoniated Pfizer Citric Acid.

**THE ADVANTAGES OF CITRIC ACID FOR PREOPERATIONAL CLEANING** are widely recognized. Now, a new Pfizer process—using ammoniated citric acid—has opened the door to safer, more efficient removal of ***operational*** iron oxides and copper deposits from high-pressure steam generating surfaces. Field testing has proved the process to be both effective and practical.

Important to the success of the process is the fact that ammoniated citric acid solutions are good solvents for iron oxide deposits. And, because of the citrate's sequestering properties, the redeposition of dissolved iron is prevented. Then, too, the same solution, with additional ammonia and an oxidant, dissolves and removes copper deposits.

This one-solution cleaning process, discovered by S. Alfano of Houston Lighting and Power Company, permits substantial reduction of total cleaning time by eliminating intermediate draining and refilling steps. (Actual cleaning operations have been completed in 8-13 hours.)

The ammonium citrate process leaves metal surfaces in a passive state—tendency to rerust is minimized—no special after-treatments required. When stainless steels are present, chloride stress corrosion problems are eliminated. Important too, citric acid is dry, nontoxic, water soluble and easily handled.

**Chas. Pfizer & Co., Inc.,**
**Chemical Sales Division,**
**New York 17, N. Y.**

I want to learn more about the use of Pfizer Ammoniated Citric Acid for cleaning steel equipment. Please send me Data Sheet 561.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

P

Science for the world's well-being®

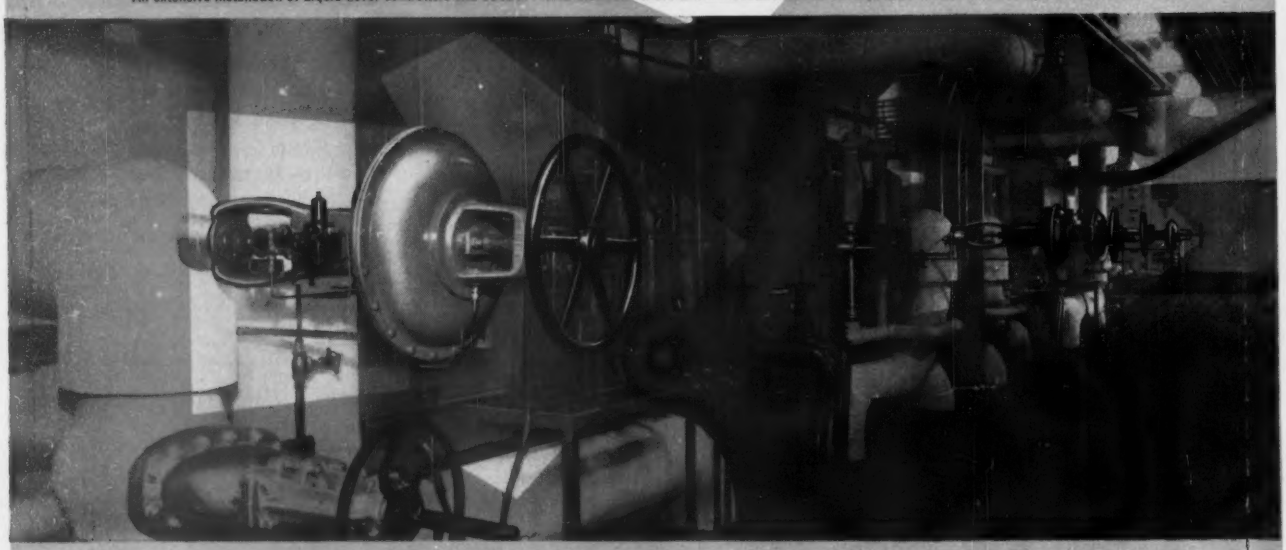
Pfizer

CHEMICAL SALES DIVISION



For more facts circle 843 on Reader Service card, p 197

An extensive installation of Liquid Level Controllers and Control Valves with Positioners to control condensers and low pressure heaters in a new generating station.



Masoneilan Angle Valves installed in the new power plant of a large eastern utility.

# MASONEILAN CONTROLS

## *Help Power Plants Achieve*

## *Design Efficiency*

More and more power plants are choosing Masoneilan controls for feed water recirculating, desuperheating, condenser and deaerator level control, heater drains, reducing stations, blow-down, fuel regulation and other services important to attaining and maintaining design efficiency.

The wide variety and versatility exemplified by the Masoneilan line of transmitters, controllers, control valves and regulators permits selection of the correct equipment for optimum control, with maximum economy measured in long-term dependability and low maintenance requirements.

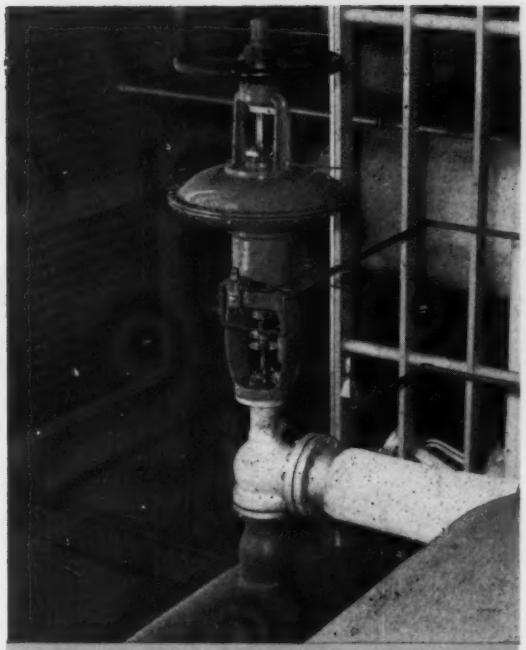
If you are concerned with the selection of power plant controls, it will pay you to investigate the advantages offered by Masoneilan equipment. Literature and technical cooperation are yours for the asking. Ask a Mason-Neilan representative or write.

*Products that Work for Your Profit*

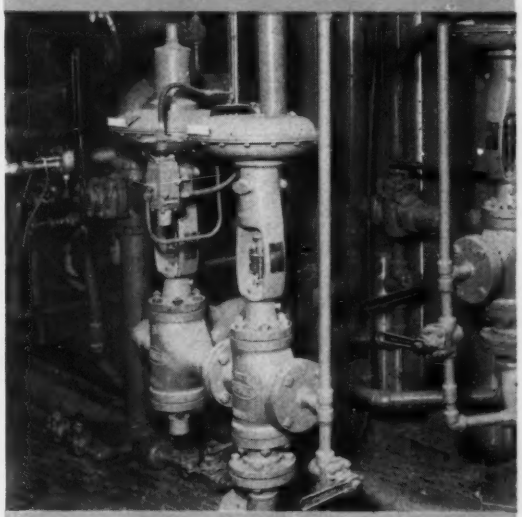
**MASON-NEILAN**

*Division of Worthington Corporation*
**33 NAHATAN STREET, NORWOOD, MASS., U.S.A.**
*Sales Offices or Distributors in Principal Cities in United States and Abroad*
*In Canada:* Worthington (Canada) Ltd., Mason-Neilan Division

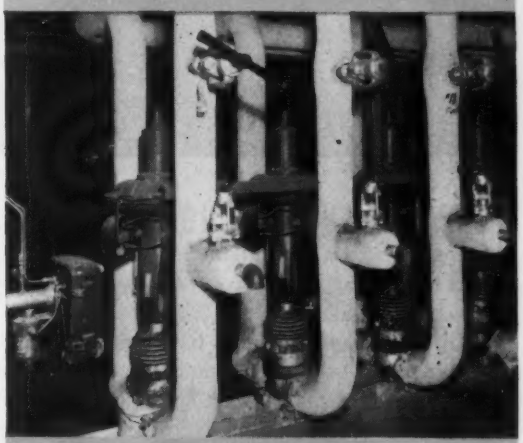
MN1-11



Masoneilan Model 777 Angle Valve, with extended outlet acting as nozzle liner, used as a drain bypass control valve.



Masoneilan Three-Way and 10,000 Series Valves used on gas firing and ignition stop service.



A bank of Masoneilan 20,000 Series Control Valves used for controlling continuous drum blowdown.

**CREATIVE ENGINEERING** at the drawing board helps solve your liquid handling problems on the job. But it takes experience . . . *plus* sweat, skill, and the spark of an idea.

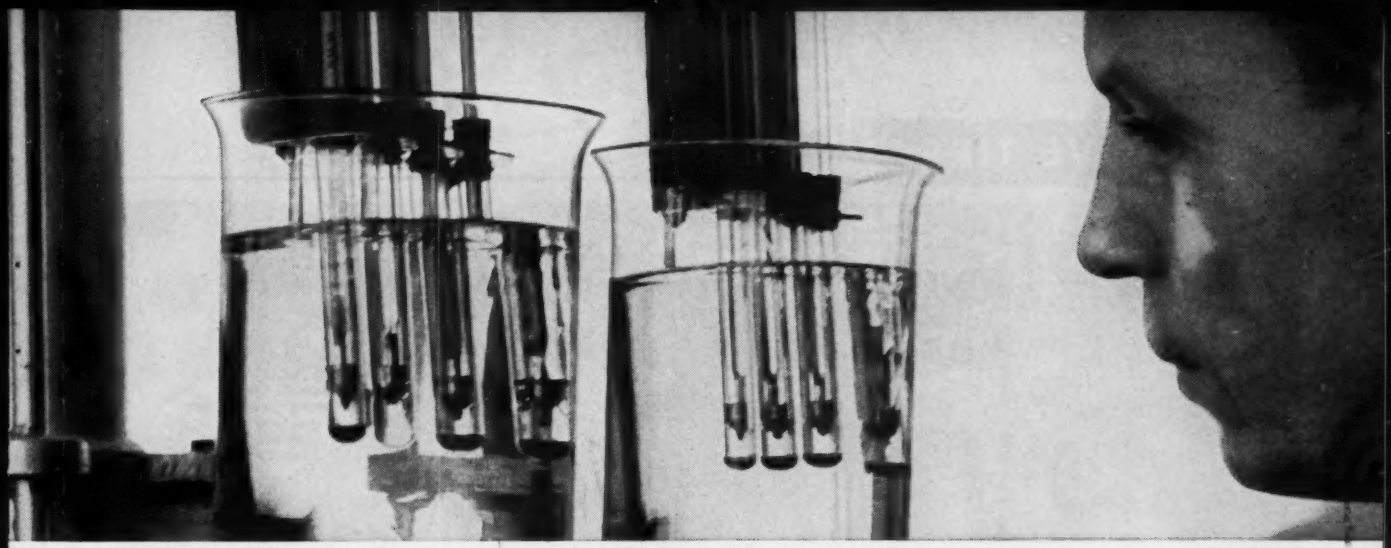
Goulds' design engineers have been "dreaming up" cost- and time-saving solutions to pump problems for over 100 years. More recent achievements include the *glassed* pump for handling corrosives, and the unique *centripetal* self-priming pump for handling liquid and vapors. Such achievements point out that every Goulds pump is built to lick a problem—perhaps *your* problem!

To find out what's available to solve your pumping problems, write to: Goulds Pumps, Inc., Dept. PO-101, Seneca Falls, New York.

**GOULDS PUMPS**



For more facts circle 845 on Reader Service card, p 197



**Dropping point test** shows how greases react to heat. Beaker fluid has been heated to 390°F. All greases tested except Darina (second tube from left) have passed from solid to liquid state.

# BULLETIN:

## Shell reveals the remarkable new component in Darina Grease that helps it save up to 35% on grease and labor costs

**Darina® Grease is made with Microgel*, the new thickening agent developed by Shell Research.**

**Darina lubricates effectively at temperatures 100° hotter than most conventional soap base greases can withstand.**

**Read how this new multi-purpose industrial grease can help solve your lubricating problems and even save you up to 35% on grease and labor costs.**

THERE IS no soap in Darina Grease. No soap to melt away—wash away—or dissolve away.

Instead of soap, Darina uses Microgel—a grease component developed by Shell Research.

### What Microgel does

Because of Microgel, Darina has no melting point. It won't run out of gears or bearings.

Compared with most conventional soap-base greases, Darina provides significantly greater protection under adverse service conditions.

Mix water into Darina and the grease does not soften. It shrugs off water—won't emulsify.

### Resists heat

Darina will withstand operating temperatures 100° hotter than most conventional multi-purpose greases. It cuts leakage and reduces the need for special high-temperature greases.

Also, Darina resists slumping, thus forming a more effective seal against foreign matter.

### Saves money

Shell Darina can reduce maintenance expenses while it protects your machinery. Savings of up to 35% on grease and labor are quite possible.

In some cases lubrication intervals have been extended to double what they were before. Less grease is consumed and less time consumed applying it.

For details, see your Shell Representative. Or write: Shell Oil Company, 50 West 50th Street, New York 20, New York.

*Registered Trademark

SHELL

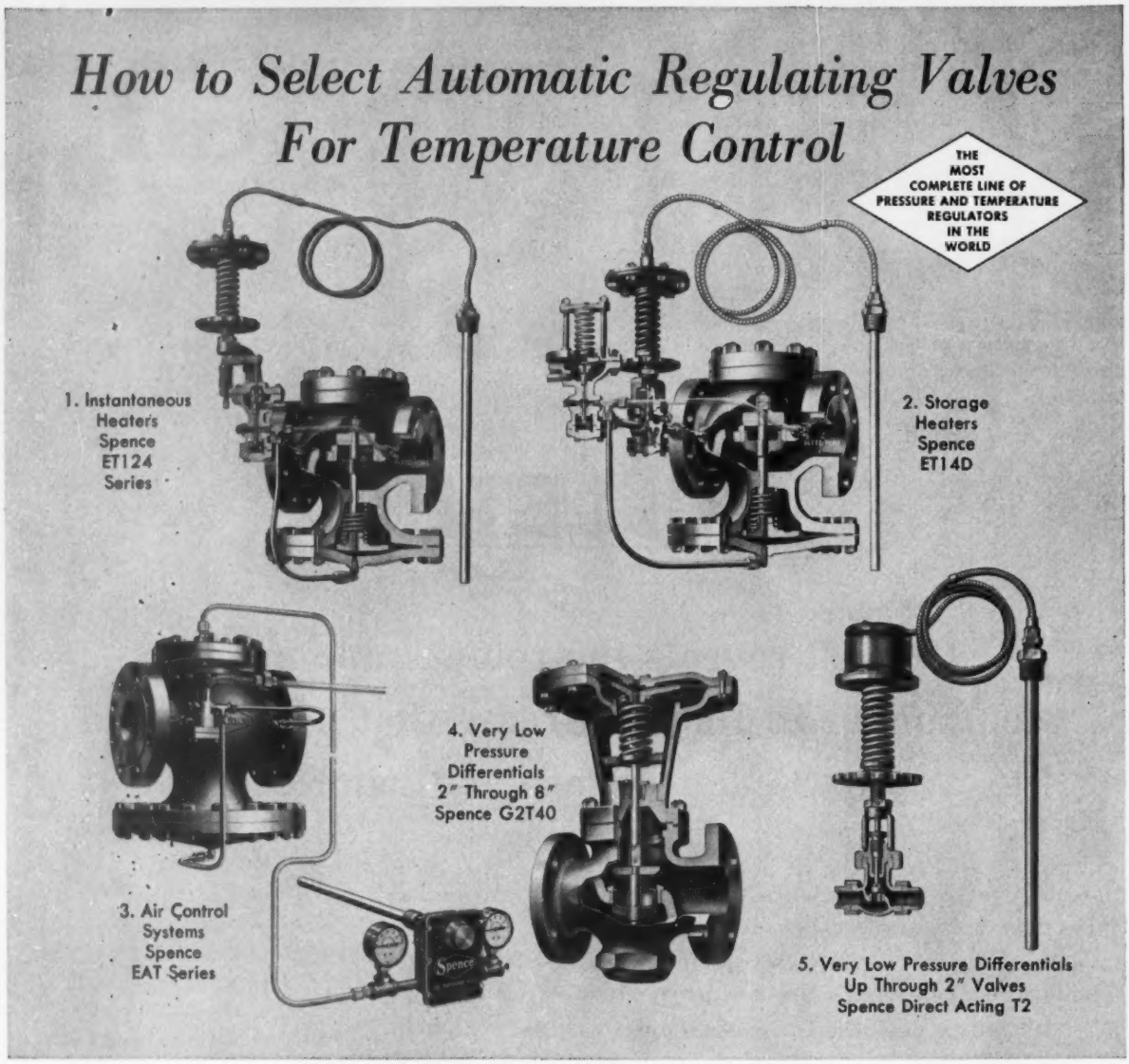
**A BULLETIN FROM SHELL**
**–where 1,997 scientists are helping to provide better products for industry**



For more facts circle 846 on Reader Service card, p 197

## VALVE TIPS:

# *How to Select Automatic Regulating Valves For Temperature Control*


THE MOST COMPLETE LINE OF PRESSURE AND TEMPERATURE REGULATORS IN THE WORLD
1. Instantaneous Heaters Spence ET124 Series
2. Storage Heaters Spence ET14D
3. Air Control Systems Spence EAT Series
4. Very Low Pressure Differentials 2" Through 8" Spence G2T40
5. Very Low Pressure Differentials Up Through 2" Valves Spence Direct Acting T2
Spence

During the past year, our field representatives have reported many cases of improperly, and uneconomically, applied temperature regulators. To help you avoid some of these costly mistakes, here are a few tips on selecting the most effective and economical temperature regulating valves for your applications.

1. Instantaneous heaters require a special action for close temperature control and freedom from hunting. In the Spence ET124 series, steam pressure is modulated according to temperature (demand) and is automatically regulated at any pressure established by the demand.
2. Storage heaters, on the other hand, are more economically controlled by the Spence ET14D, which includes a simple temperature-actuated pilot that opens and closes the main valve to maintain a constant temperature.
3. Air control systems can now have a ±5°F control accuracy under wide and instantaneous load swings with the Spence EAT regulator. Engineers report savings of up to 50% in installed costs with this recently developed Spence cascade system when it has been used in place of conventional instrumentation.
4. For the combination of very low pressure differentials and air or water control, Spence recommends Type G2T40. This single seated valve provides fast, positive response in 2" through 8" valves. Double seat Type G22 is also available in 10" through 12".
5. When very low pressure differential is encountered with valves of 2" or less, the Spence direct operated T2 is recommended. The sensitive vapor tension thermostat responds quickly to small changes in bulb temperature for continuous, accurate control.

In this brief description of industrial process and heating temperature control, we have given a few important tips in proper regulator selection. If you would like more detailed information on these control applications, write for the new Spence Temperature Control Bulletin IV 1014. 8E-150

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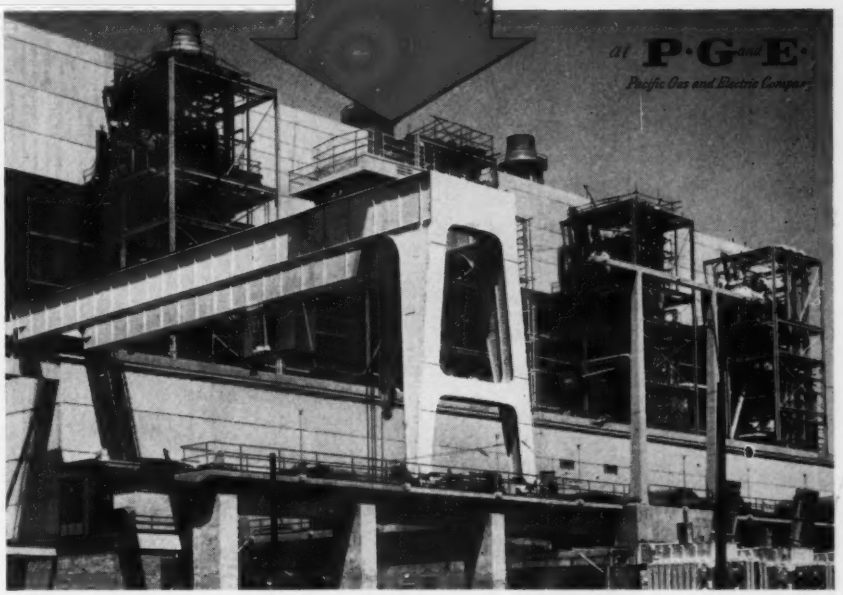


The turbine area of Pacific Gas and Electric Company's 990,000 kilowatt Pittsburg, California power plant is serviced by a Yuba 60-ton semi-gantry crane with a 120-ft. span.

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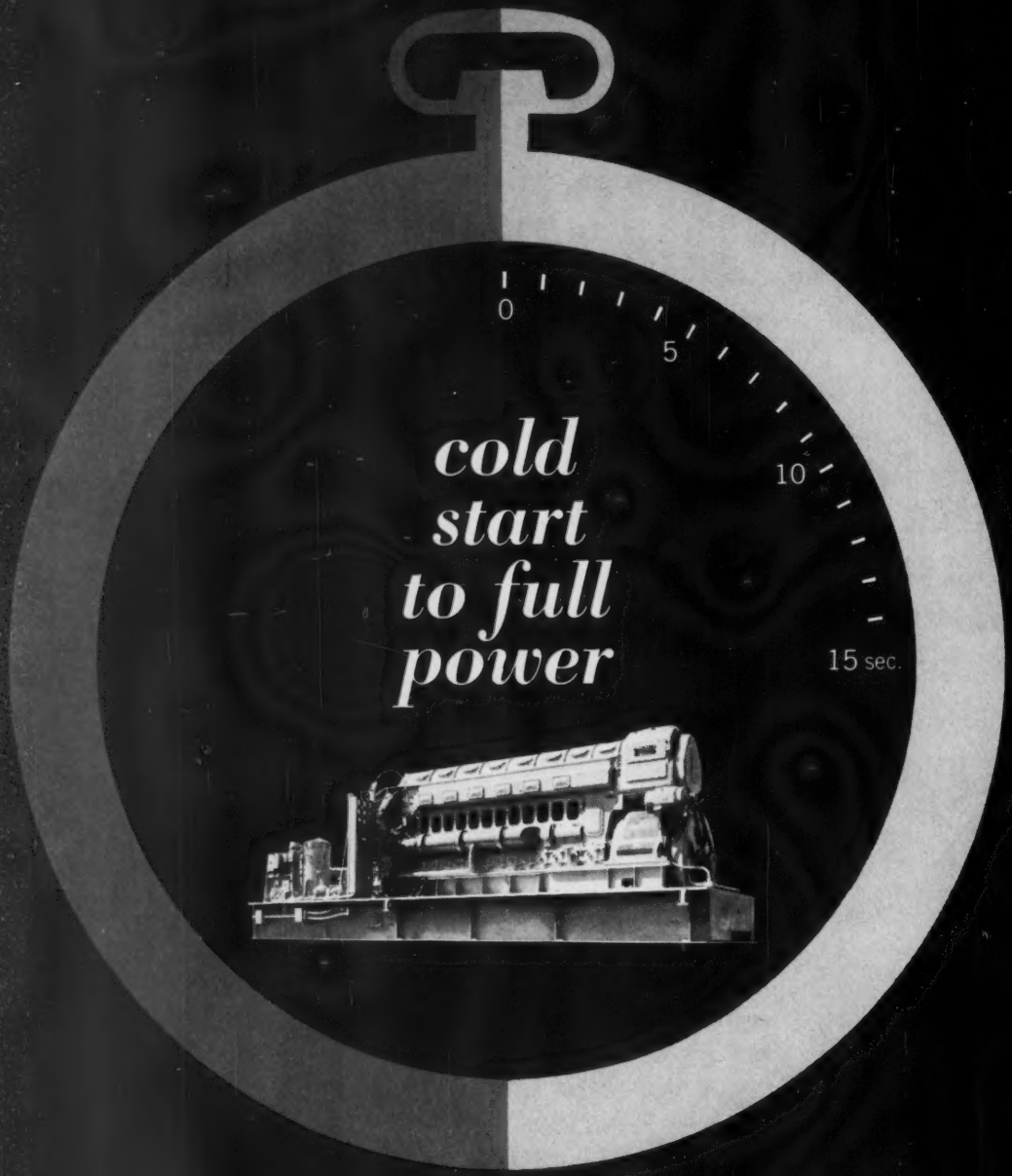


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The F-M 38D8⅛ Opposed-Piston Diesel Generating Unit—with only 15 seconds *from cold start* to full power—gives fast, sure power for peaking or for standby use, together with impressive operating economies.

This unit requires no spinning reserve . . . uses no power until it starts, then produces up to 2500 kw per unit. Can be linked in multiple units.

Dependable? Service records of F-M Diesels prove dependability beyond a doubt (F-M pioneered the manufacture of diesels in America . . . has kept in the forefront ever since.)

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Opposed-piston design minimizes vibration, produces fine balance . . . smooth power and instant response that result in 15 second full-power operation. Available with 4, 5, 6, 8, 10 or 12 cylinders, ranging from 450 to 2500 kw per unit, with automatic or manual controls. **For full details or custom specifications, write today to: S. K. Howard; Director of Marketing; Fairbanks, Morse & Co.; Beloit Division; Beloit, Wisconsin.**

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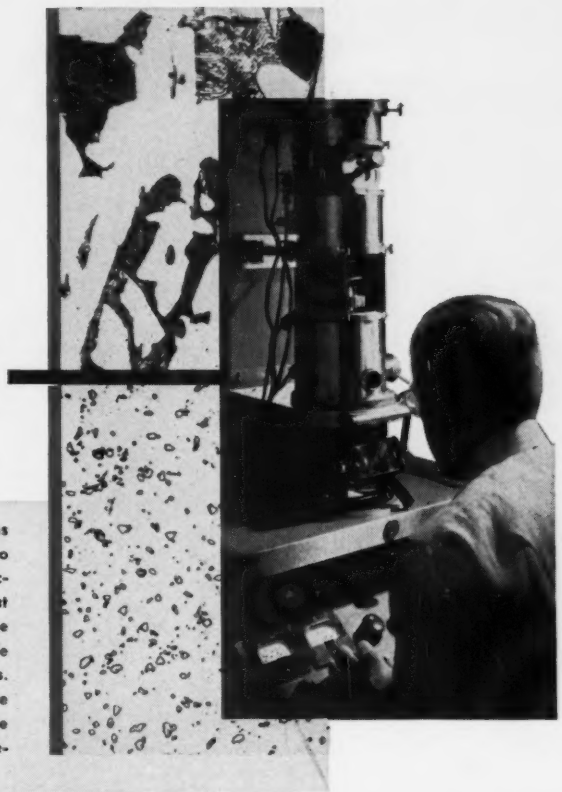
# It Should Never Happen To You...

## ...But When It Does, You Need Expert Advice!

### Nalco's Specialized Metallurgical Skills and Facilities Find Causes; Prevent Metal Failures

A ruptured boiler tube is a catastrophe wherever and whenever it occurs. The one shown above, sent to Nalco Laboratories for metallurgical analysis, revealed that prolonged overheating was the basic cause, with several contributing factors. Recommended changes in chemical treatment and operative procedures can help prevent recurrence.

Boiler metal failures are not a frequent occurrence in modern steam plants. But with thousands of operating boilers in service, failures do occur . . . enough of them to make necessary keeping Nalco's specialized metallurgical skills and facilities at work analyzing failures and their causes, with the continuing aim of developing "failure-proof" chemical treatment and control techniques.



**Carefully selected, ground, polished, and etched steel specimens give up their secrets under metallographic microscopes at Nalco (right). At left top is a normal low-carbon steel boiler tube structure, showing the intermixed crystals of ferrite and pearlite at 500 magnifications. Below normal structure is a section of tube metal at the same magnification which has developed carbide spheroidization, indicating undesirably high metal temperatures. This change in structure occurs after prolonged heating in the range of 900° F. to 1350° F., and is a combined function of time and temperature—occurring very slowly at 900° F., but often requiring only a few hours to develop at 1350° F.**

Nalco's accumulation of metallurgical research and experience may be helping to protect your boiler metal against failure right now. Nalco was first among water treatment organizations to recognize the importance of metallurgy and metallography in complete water treatment services . . . And first to install the facilities and experts to track down the frequently obscure causes of metal failure. Finding preventive measures, both chemical and physical, has been going on in the Nalco Laboratories for about 25 years.

Complete metallurgical analysis must take in the entire situation. At Nalco, such a complete investigation may include water analysis, gravimetric analysis, flame photometry, X-ray diffraction, electron microscopy, and electron diffraction and spectroscopy. To our knowledge, Nalco is the only water treatment organization capable of making such complete investigations in this highly specialized field. For further data on boiler metallurgy, write for free Nalco Bulletin 61, and Nalco Reprint 32. To obtain prompt consultation regarding water treatment problems, call your Nalco Representative.

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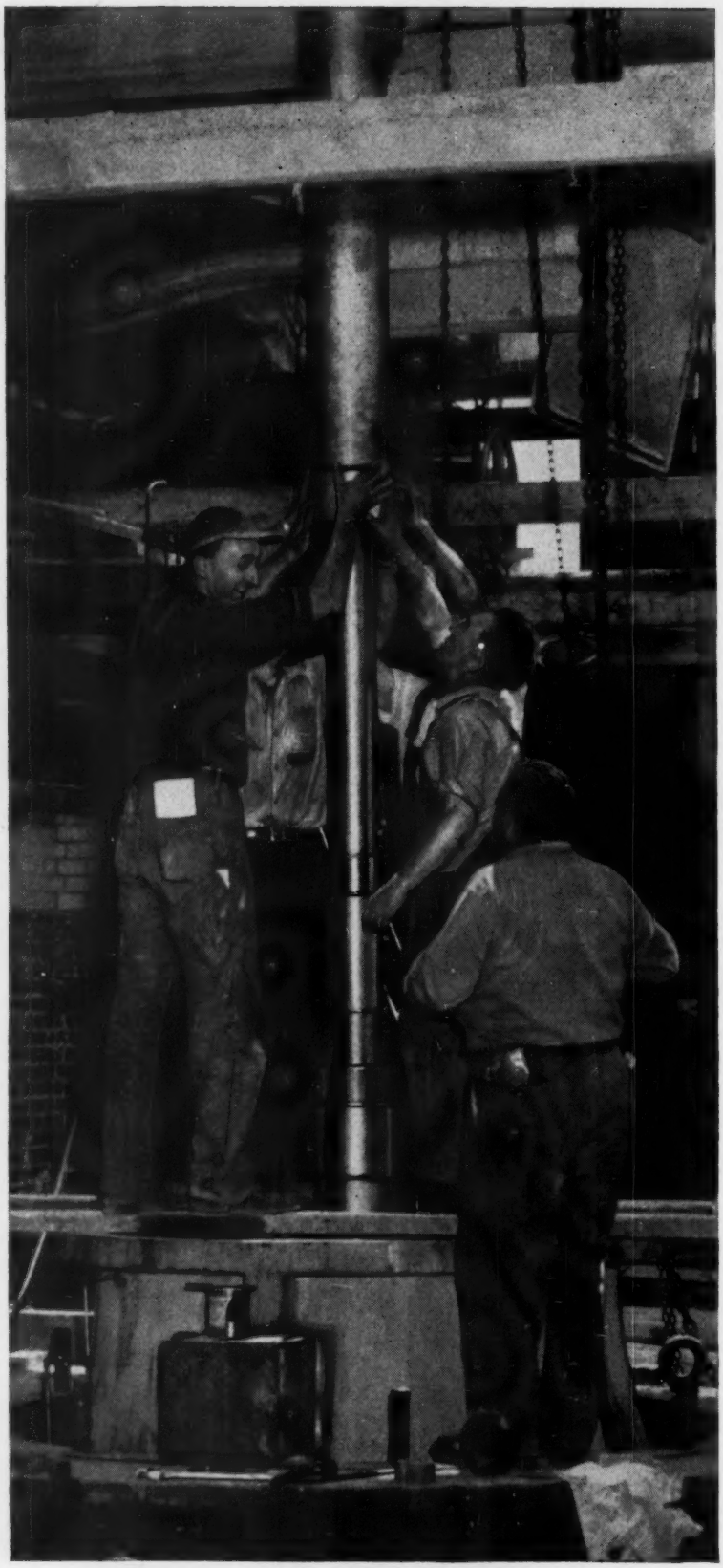

# Here's why circulating and feedwater pump shafts made of MONEL Alloy K-500 last longer

MONEL* alloy K-500 (formerly sold as "K" Monel alloy) has a unique *combination* of properties ideally suited to meet the shaft requirements of circulating and feedwater pumps. These properties include:

- **High strength,** toughness, and torsional properties for transmitting power with minimum vibration.
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- **High fatigue resistance** to the repeated stresses that high-speed pump shafts must undergo.
- **Resistance** to corrosion and corrosion-fatigue in sea or brackish water.
- **Galvanic neutrality** when coupled with bronze pump bodies and bearings.

For information about how MONEL alloy K-500 shafts provide dependable, long service in power applications, send for our Technical Bulletin T-9 and folder, "Practical Answers to Pump Problems." Just write to:

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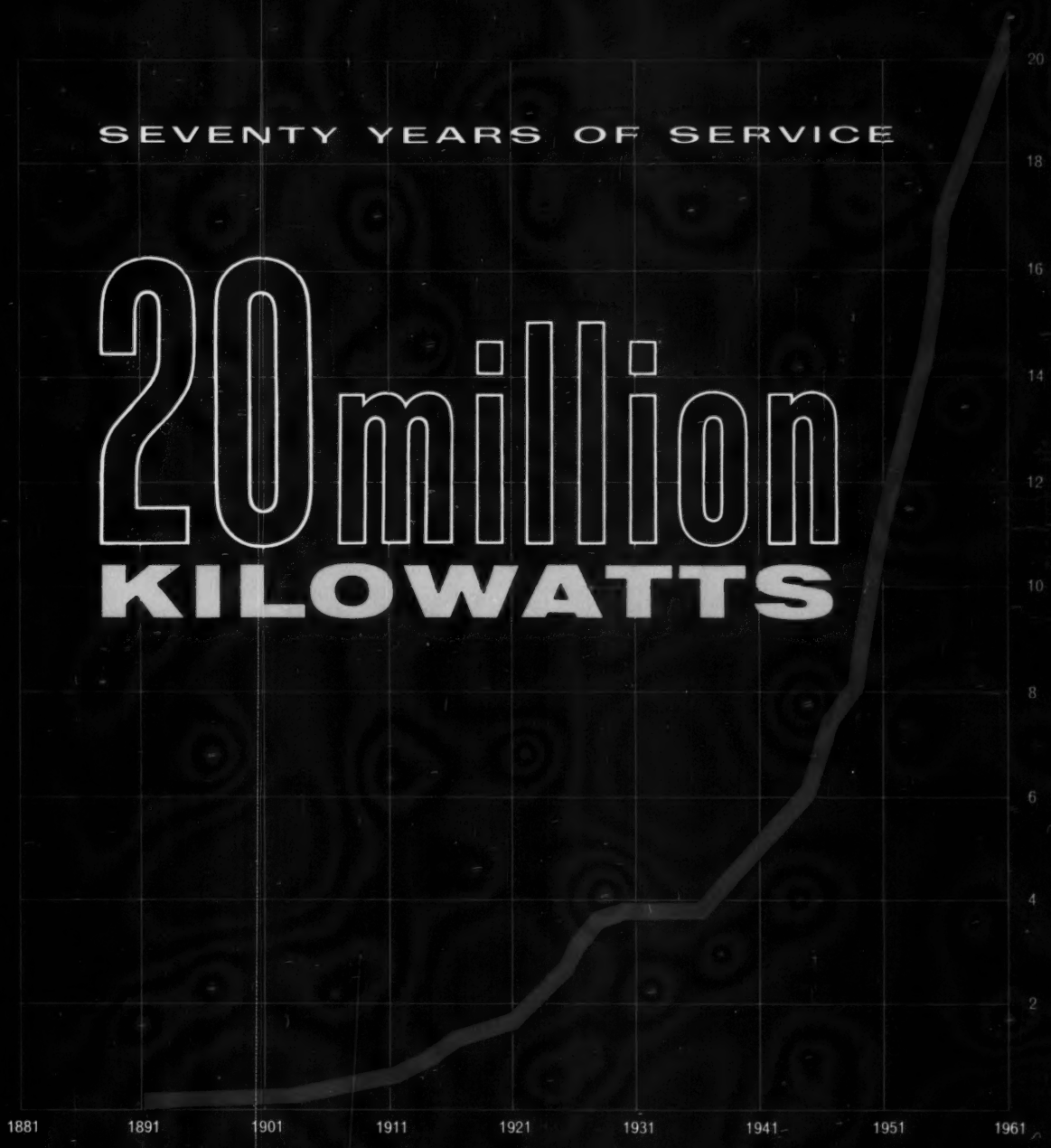


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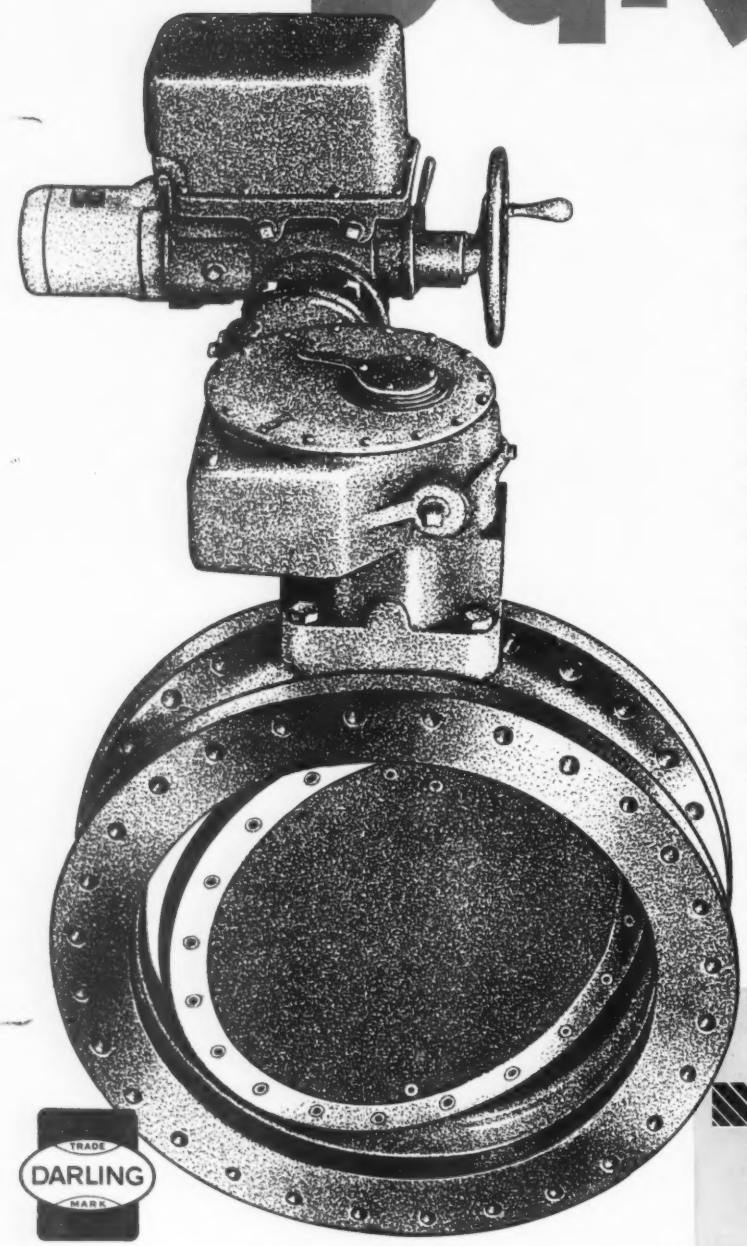


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Darling-Pelton Butterfly Valves have a continuous 360° rubber sealing ring, uninterrupted by the valve shaft, that makes complete drop-tight shutoff possible. The valve disc, swinging on an axis eccentric to the valve centerline, is exceptionally easy to operate. It lifts away from the body seat on opening to eliminate any abrasion or distortion. The rubber seat can be replaced quickly without dismantling the valve. *You can depend on* Darling-Pelton Butterfly Valves for safety, long service, superior performance.

Write, wire or phone for your copy of Bulletin 5904 giving complete information on these butterfly valves made to A.W.W.A. Specifications.

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*The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ontario, Canada*
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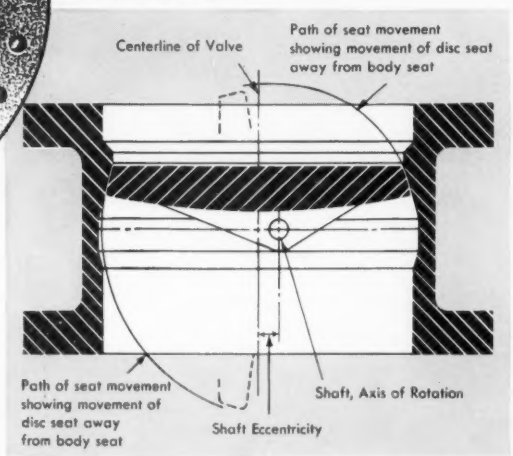
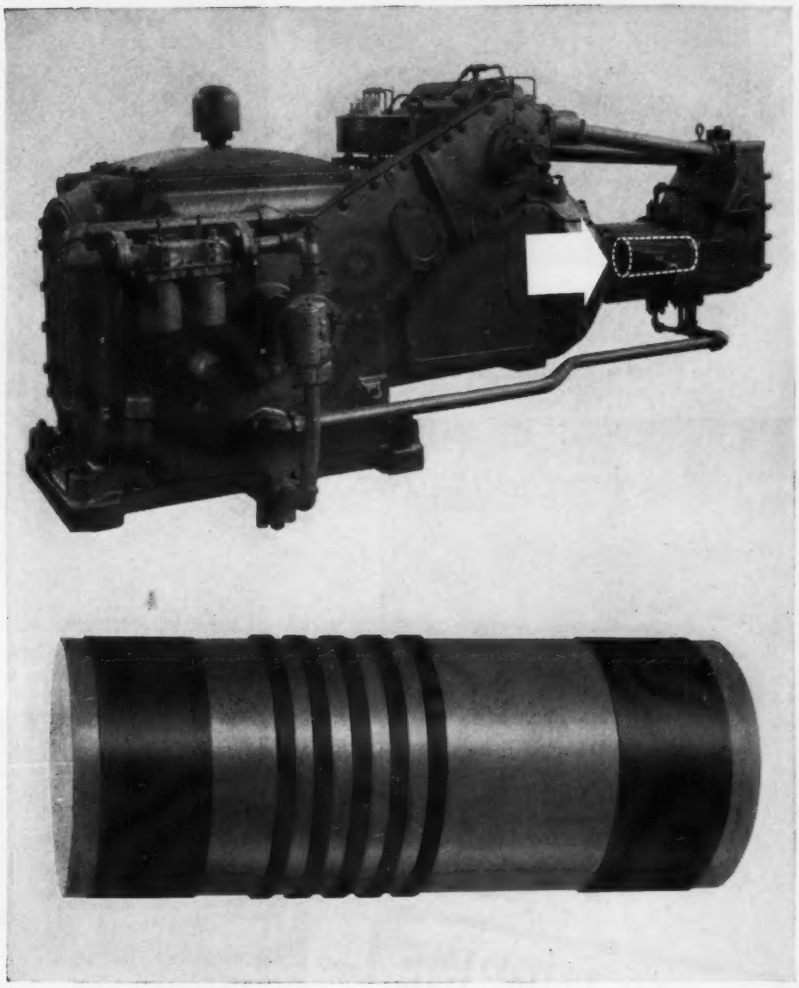
**Exaggerated diagram showing eccentricity of valve shaft in relation to valve axis and how the disc, upon opening, is lifted from the body seat throughout its entire circumference.**


Centerline of Valve
Path of seat movement showing movement of disc seat away from body seat
Path of seat movement showing movement of disc seat away from body seat
Shaft, Axis of Rotation
Shaft Eccentricity

**Cooper-Bessemer applies** Garlock Teflon* Piston and Rider Rings (bottom, to prevent leakage and assure proper piston support) on the Type FXA expander engine (top). In a special closed-loop test, the engine is evaluated over a wide range of conditions in the process of air liquefaction.



# NEW ENGINEERED TEFLON PISTON RINGS for Non-Lubricated Service

**Cooper-Bessemer chooses Garlock Teflon Piston and Rider Rings for severe duty on their new FXA expander engine.** Against pounding 2000 p.s.i. pressures, and at temperatures that dip to an icy −270°F, the Teflon rings seal tight without lubrication on the power piston of an expander engine that provides various gases at cryogenic temperatures, while harnessing power at the same time.

**Cooper-Bessemer is optimistic about the new** Garlock Teflon Piston and Rider Rings. Since inception of the Type FXA gaseous expander engine, the rings have performed with negligible wear, and have eliminated the most undesirable hazard in an oxygen plant—contamination of the gas either from lubrication or from the ring materials themselves. Teflon Piston and Rider Rings need absolutely no lubrication and are unaffected by—and do not affect—gases, chemicals, and most other process materials.

**The first really satisfactory rings** for non-lubricated service, Garlock Teflon Piston and Rider Rings will not crack or break, will not score cylinder walls, and are flexible for easy installation . . . withstand temperatures from −420°F to +500°F; available in carbon-filled or glass-filled Teflon in either butt joint, step joint, scarf cut or solid.

**On this application,** Cooper-Bessemer also applies rod packing rings and scraper rings—more of the complete line of high-quality Garlock metal packings. If you have a sealing problem, ask your Garlock representative for assistance. Call him at the nearest of the 26 sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalog AD-178. Garlock Inc., Palmyra, N. Y.

**Canadian Div.:** Garlock of Canada Ltd. **Plastics Div.:** United States Gasket Company. **Order from the complete line** of quality Garlock products . . . Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Shapes and Parts.

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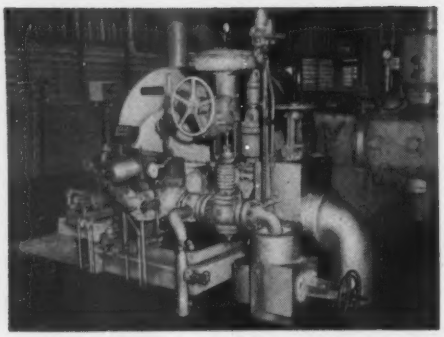
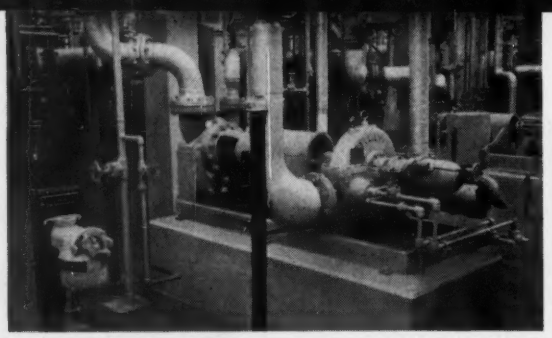
# GARLOCK

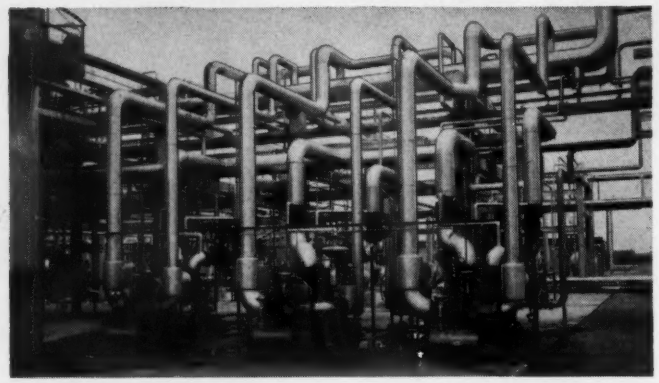


600-hp Elliott turbine driving a compressor which supplies compressed air for process.

(Right) Elliott steam turbines power many reflux pumps throughout the refinery. Shown here are three, driving gasoline column bottoms pumps in the crude unit.



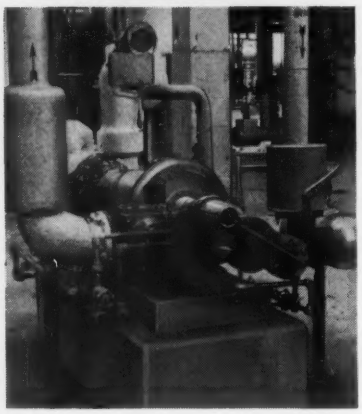
The YR turbine shown above drives an oil pump in the alkylation plant.



The turbine-driven condensate pump shown below charges foul condensate to stripper column.

Below are forced-draft fans driven by Elliott turbine-gear units in one of the refinery's boiler plants.

The unit on the left above is a condensate pump, and the one on the right is a seal oil and flushing oil pump. Both are driven by Elliott turbines.



FROM TURBINE HEADQUARTERS

# In one refinery, 85 Elliott turbines driving pumps, compressors, fans prove Elliott versatility

Ranging in size from 5 to 935 horsepower, these Elliott YR single stage turbines are installed in a giant East Coast Refinery. The units were selected from a modern, field-proven line of mechanical drive turbines rated up to 50,000 horsepower.

Installations like this together with experience of more than 50 years in turbine design, manufacture and application are among the reasons why Elliott is truly "Turbine Headquarters." Write for descriptive bulletin H22-D. H1-2

day-in/day-out

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2

# *Power* reports on . . .

# Central Station Design

Demand for increasing energy service finds ready, improved sources developed with an eye to economy. Clever design counteracts steadily rising costs

**Turnkey contract** with manufacturer at a fixed price gets steam-plant tryout. Here's what the industry thinks about it. **p 146**

**European heat balance** innovation aims to use the last Btu with maximum effectiveness by keeping its temperature high. **p 148**

**Binary-vapor-cycle** proposal would use backpressure steam turbine topping refrigerant fluid driving radial-inflow turbine. **p 149**

**Flash evaporators** offer heat-balance advantages that put them on par with demineralizers for makeup treatment. **p 150**

**Oil and gas engines** get more output by upping mep's and more flexibility by burning wider variety of fluid fuels. **p 152**

**System load division** is controlled by digital-computer-directed system for 34 generating units at nine stations. **p 153**

**Pumped-storage hydro plants** increase their numbers in U.S. and Canada as they offer economy on growing systems. **p 154**

**Nuclear power plant** development pushes into a proving period for major equipment, includes work on small-capacity plants. **p 155**

**Plant-equipment materials** use advanced alloys to meet operating problems at both high- and low-temperature ends of plant. **p 156**

**Data loggers** and performance monitors will see service in over 34 new units as first step to automatic plant control. **p 158**

# "TURNKEY" CONTRACTS
## . . . a survey of current thinking

**Late in 1960, Texas Electric Service Company contracted with the Westinghouse Electric Corporation to build a complete 350-mw extension to their Handley Station. This was the first time that an equipment manufacturer had taken such an overall contract for a conventional domestic generating unit.** It was immediately called a "turnkey" and many people took sides on its advisability and on whether it would change the historical pattern for building large conventional steam-electric stations.

**Some of the dust has now settled** and there has been time to review this construction method with many executives of utilities, consulting-engineering firms, constructors and major equipment manufacturers. Their consensus will aid you in forming an intelligent opinion.

But before going into the advantages and disadvantages as they see them, let's try to clear up a few misunderstandings. First of all, there are many kinds of turnkey contracts, and turnkey contracts as such are not new in the utility business. In fact, almost all power-plant construction involves one or more turnkey contracts—an example might be a central-station insulation contract. Many conventional power plants built by a contractor or an engineer-constructor are in effect turnkeys. In some cases the contractor holds a general contract and hires subcontractors for specific portions of the job. In other cases the general contractor may be an agent of the owner and act in his name. An engineer-constructor, too, may hold either of these relationships to the owner.

**Methods of payment** differ widely. Usually the contracts provide cost plus a fixed fee or cost plus a fixed percentage. Fixed-price contracts are less common. In any event, the normal contract has historically been between the owner and a firm whose principal job is engineering, construction or both.

**What's new** at Texas Electric Service Company is that this contract is between an owner and a *manufacturer* of a major component of the plant, and that it provides for a *fixed price*. More descriptively, this is a "manufacturer's fixed-price turnkey."

**On a broader scale** a manufacturer's turnkey contract has not been uncommon. Many of the nuclear-power plants now under construction or already on the line were built in this manner. The Oklahoma Gas & Electric Company has such a contract with General Electric Company for a combined-cycle (gas and steam-turbine) power plant, but here the novel cycle was a compelling factor. Similar contracts are also quite common in the refinery and petrochemical industries where system designs are similar and equipment is of the same general class. And organizations like International General Electric Company and Westinghouse International have built many large power plants in Europe and Japan in this manner.

Now let's look at some advantages and disadvantages, as seen by executives of the electric-generating business.

**Unified responsibility** is probably the big advantage. This greatly simplifies relationship between owner and builder. One contractor is completely responsible for all aspects of the job—not only successful construction but also performance guarantees. Since owner need deal with only one man, he can't become involved in a merry-go-round where responsibility might be bounced back and forth without ever really coming to rest.

Lower cost is also cited. Certainly the Texas Electric Service Company unit carries a low contract price, but remember that this figure cannot be compared across the board with average cost of utility construction. The Handley addition is a wholly outdoor, gas-fired unit; these factors hold costs down, of course. It was purchased at a time when the utility equipment market was relatively soft. In fact, another Southern generating plant, currently being built in the conventional manner, should closely approximate Handley's figure of $80.00 per kw of rated capacity. So the low contract price at Handley may not be a direct function of the turnkey feature.

**Probably the greatest disadvantage** that industry executives see is owner's loss of control over design details. Once the contract is let, owner is in effect bypassed on most subsequent decisions. He cannot communicate directly with all equipment manufacturers; he loses the benefit of their thinking on possible improvements which might be included in his plant. This is especially important where something more than a bare-bones plant is involved—and remember, most plants are *not* bare-bones

### A case in point—Texas Electric

J B Thomas, President and General Manager of the Texas Electric Service Company, presented his case for this contract in POWER's April '61 issue. An attractive price of $80 per kw of rated capacity would come through several design innovations. Unified responsibility resulting from the single overall contract (with the turbine-generator manufacturer) for the entire addition would be a simplified and direct means of gaining the desired end. End product, of course, is an operating 350-mw unit, coming up to guarantees in all respects.

Standardized 350-mw design would bring further cost reduction—future, duplicate units would be manufactured repetitively. Other design factors contributing to the low unit cost included:

(1) Fully outdoor construction

(2) Extraction heaters placed on or directly attached to the condenser and l-p turbine assembly

installations that are built to a minimum specification.

Proponents think plant duplication may further drop engineering costs of future plants, but this case may be rare. So many facets of the overall design must fluctuate with site, cooling-water availability and temperature, fuel costs and load characteristics. Duplication also presumes that steam-electric power-plant design will remain as is. Is this realistic? For many utilities, innovation and improved design has been the general rule. Some units of identical capability, built side-by-side and only a few years apart, are considerably different. Designers took full advantage of advances in the interim.

**Some general considerations** should be pondered. These questions might be asked: What if manufacturer's fixed-price turnkey contracts became the general rule rather than the exception? What effect would this have on progress in the electric-generating industry? What would be the overall effect on equipment manufacturers, consulting-engineering firms, utility construction firms? Here are some possibilities:

Historically, construction of a steam-electric generating station has involved one consulting-engineering firm who might be the constructor as well. At Texas Electric Service, however, the owner retained one consultant, Ebasco Services Incorporated of New York, and the Westinghouse Electric Company employed United Engineers and Constructors of Philadelphia. Can two consulting-engineering firms, even though they split the work, be as inexpensive as one consultant for the whole job?

Were this manufacturer's fixed-price turnkey scheme to develop, might it not be logical for the major manufacturing contractors to beef up their engineering and construction divisions, eliminating at least one consulting firm? This could mean considerable realignment of personnel between consulting engineers and major manufacturing contractors. And when a consultant is employed by the manufacturer-contractor, can he act in his true professional capacity to serve the owner's best interests? Must he not necessarily favor his employer's equipment?

Under the usual contract setup, a component manufacturer prepares a bid for his equipment and submits it to consultant or owners direct. This bid is usually valid regardless of who ultimately builds the plant. But with a manufacturer's fixed-price turnkey, the same component manufacturer might have to bid to several manufacturer-contractors and it is unlikely that their specifications would be the same. He would have to prepare several different bids for each job. Bidding costs money, which can only be retrieved by raising equipment prices.

Turbine-generators and boilers are the two largest single items to be purchased. So it is logical that, should fixed-price turnkey contracts catch on, boiler as well as turbine-generator manufacturers would participate. But is this logical? These equipment items are entirely different. Should either manufacturer be held responsible for the design and performance of the other unit?

**One final thought:** In some quarters, concern is expressed about the possible effects of manufacturer's fixed-price turnkey contracts on the fortunes of smaller, independent manufacturers.

Those feeling such concern point out that it would be reasonable to assume that the manufacturer making a turnkey bid would use as much equipment of his own make as possible. This could sharply reduce potential markets for specialist builders of items such as steam condensers, heaters, pumps, motors. Markets could be further cut if, as seems likely, some specialist builders entered working partnerships with broad-line makers.

Many industry observers believe that innovation and engineering progress flourish best when competition is freest and when there are ample incentives for specialist builders to develop independent design approaches.

**Consent decrees** resulting from recent price-fixing convictions may also affect future of manufacturer's fixed-price turnkey contracts. Early decrees require separate pricing in overall bids, which could make turnkeys unattractive. The picture isn't clear yet, but it's possible that this factor alone may sound the death knell of manufacturer's fixed-price turnkey contracts.

**Only time will tell** the success or failure of the manufacturer's fixed-price turnkey, but today's consensus indicates that disadvantages outweigh advantages, and that turnkeys will not develop as a major factor in construction of steam-electric generating stations in the U.S.

## Service Co's Handley addition

(3) A low-set twin-side-outlet steam condenser

(4) Full-capacity main boiler-feed pump driven through a hydraulic coupling from a turbine-shaft extension. (A 30%-capacity motor-driven emergency and startup boiler-feed pump is provided)

(5) Greatly simplified valving and piping

(6) Main leads from side of generator connecting directly to adjacent stepup transformer

(7) Electric controls located at or on generator support structure

(8) Boiler located nearby with water-handling and fuel-burning equipment as a unit

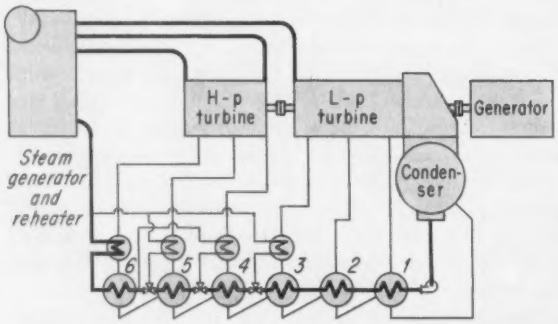
(9) Control room and data-logging equipment placed immediately at turbine support structure

(10) Substantial regrouping of turbine and auxiliary units so more of the turbine generator can be assembled at the factory and unit can be fitted for much easier and quicker field assembly

# HEAT BALANCES ...improve, squeezing out the last Btu

**Steam-turbine heat balances may be improved by a patent issued to Dr Jaroslav Nekolny of Prague, Czechoslovakia. His development applies to a regenerative steam cycle using one stage of steam reheating** (Fig. 1 to 3). The last four h-p heaters bleed superheated steam from the turbine. Instead of integral desuperheating sections taking full feedwater flow, this arrangement has the bleed steam enter separate desuperheater heat exchangers before each heater. These desuperheaters take only a small fraction of the feedwater flow to keep outlet water temperatures about 10-F below incoming steam temperature.

**Preserving high temperatures** within the cycle minimizes degradation of available energy, raising the thermal efficiency of the entire plant. To follow through with this aim, the high-temperature desuperheating water is delivered to a point where it mixes with the main feedwater at about the same temperature.

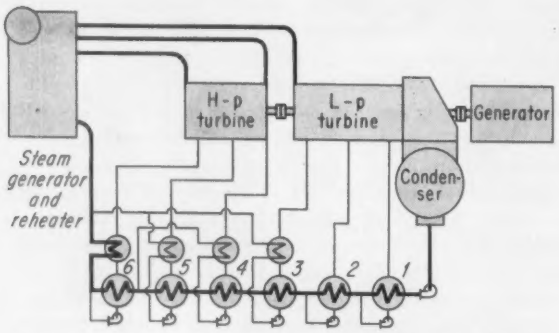



1 Regenerative cycle with cascading bleed condensate uses separate desuperheating exchangers to hold high water temperature

Fig. 1 shows the cycle with the bleed-heater condensate cascading back to the main condenser. Heaters *3* to *6* have a desuperheater between them and the bleed points; heaters *1* and *2* get wet bleed steam. A proportioning valve after heater *3* diverts a small part of the feedwater to its desuperheater. Heated water leaving the desuperheater then joins the main feedwater after high-temperature heater *6*. Note that heater *3* gets relatively high-temperature steam after the reheater, about the same as heater *6* after the throttle.

A proportioning valve after heater *4* sends a small flow of feedwater into its desuperheater. But the heated water joins the main feedwater after heater *5*, because its temperature is lower than that leaving heater *6* (since bleed steam to heater *4* is less than that to heater *3*).

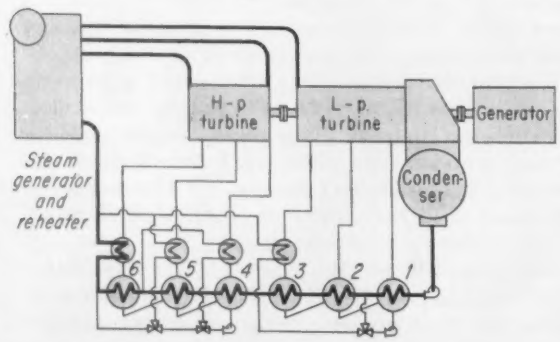
On the other hand, diverted feedwater flowing through the desuperheater of heater *5* rejoins the main flow after heater *6*. Heater *6* can have an integral desuperheater since almost all the feedwater flows through the desuperheater; diversion has no thermodynamic advantage.




2 Separately pumped heater condensates may develop slightly higher cycle thermal efficiency using separate desuperheaters

**Same main equipment** is used in Fig. 2, except that all the feedwater heaters with individual condensate pumps can be contact types. Here bleed condensate for each heater bleeding superheated steam passes through its respective desuperheater. Heated condensate then joins the main feedwater, as it does in Fig. 1.

Fig. 3 combines the arrangements of Fig. 1 and 2. Bleed condensate of heaters *5* and *6* cascades to *4*. Proportioning valves in the bleed-condensate line divert water flows to desuperheaters of heaters *4* and *5*. Bleed condensate of heaters *3* and *2* cascades to heater *1*. Proportioning valve in the bleed-condensate line diverts water into desuperheater *3* as needed.




3 Combination of cycles in Fig. 1 and 2 may be good compromise between economical performance and capital costs of equipment

The patent claims that optimum performance depends on three points: (a) water flow through desuperheaters about equals bleed-steam flow (b) water temperature entering desuperheaters about equals saturation temperature of bleed-steam pressure (c) water temperature leaving desuperheaters is not less than about 10-F lower than entering bleed-steam temperature. So far, Czechoslovakia, Austria, England and France have awarded patents on the idea. Patent application 719,371 is filed in the U.S.A.

# BINARY CYCLE ...proposes to boost thermal efficiency

**Taking full advantage of the temperature head from superheater outlet to cooling-water inlet insures top thermal efficiency in power-generating cycles. Worthington Corporation's David Aaronson proposes to do this with a binary-vapor cycle—steam at the high-temperature end topping dichlorodifluoromethane at the low-temperature end.** The lower-temperature "refrigerant" fluid is nicknamed Payon-12, a humorous reference to "working" fluid.

**Simplified cycle** below shows how the idea would work with a superpressure steam unit, but with the 200-mw steam turbine exhausting at 22-psia backpressure. Here 60% of 285-F exhaust steam enters the Payon-12 boiler-superheater where it condenses at 232 F. Feed pumps pass the water back to the steam boiler through the feedwater heaters.

Remaining 40% of the exhaust steam enters the bleed-steam turbine to generate 8 mw. The steam bleeds to successive heaters which raise the temperature of the liquid Payon-12 returning to the Payon-12 boiler-superheater from the condenser. Bleed-steam condensate cascades through the heaters to the l-p heater; then it's pumped back to the Payon-12 boiler for return to feedwater cycle.

The 660,000 lb per hr of 285-F exhaust steam evaporates and superheats 16.9-million lb per hr of Payon-12 at 500 psia to 230 F (15-F superheat), a temperature drop of 55 F. The Payon-12 superheated vapor enters a single-stage radial-inflow turbine developing 50-mw output. This turbine, based on types used in large-capacity refrigerating cycles, is expected to work at engine efficiencies up to 92% for this rating.

**At 92% engine efficiency** the binary cycle lowers overall cycle heat rate by 180 Btu per kwhr and produces 5.4 mw more in net output, compared to a conventional superpressure cycle using a condensing l-p steam turbine.

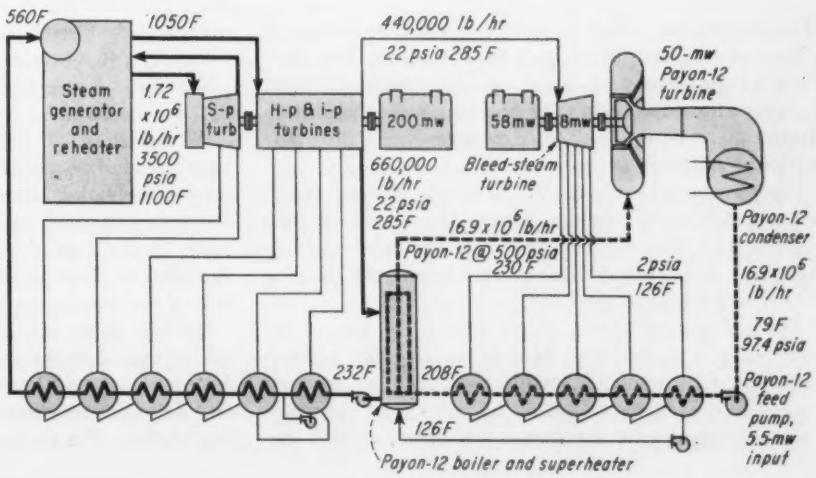
**Payon-12 boasts high safety** in terms of nonflammability, nontoxicity and noncorrosivity. It freezes at −252 F. Low latent heat and heat drop in the turbine give a ratio of 16-lb Payon-12 to 1-lb steam in the cycle below. But volume flow of Payon-12 is much less than that of steam at the same temperature because of the higher saturation pressure (see cycle for 79 F at 97.4 psia).

At 79 F, volume flow of Payon-12 for same energy duty is only 1% that of steam; at 40 F this drops to ½% that of steam. But since the allowable velocity of Payon-12 is one-third that of steam, we find that flow-passage areas for Payon-12 are 3% the size of those for steam at 79 F, 1½% at 40 F, making Payon-12 turbine relatively small.

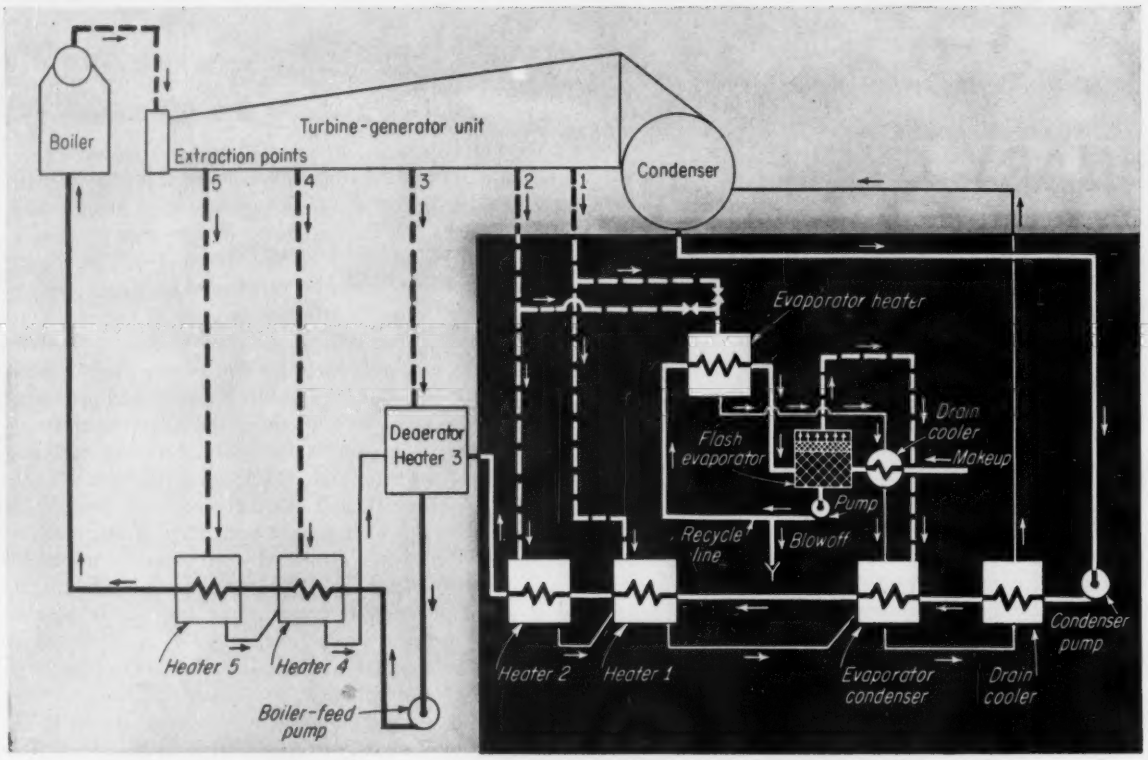
**Disadvantages of the binary cycle** compared to all-steam: (1) more heat-transfer surface (2) high pumping energy (3) high internal temperature drop (4) finned tubes in condenser (5) Payon-12 costs about 30¢ per lb.

**Advantages of the binary cycle:** (1) higher engine efficiency of the Payon turbine (2) higher plant thermal efficiency and capacity (3) ability to use low condensing temperatures (4) smaller volume of equipment at low end of cycle leads to saving in equipment and building costs (5) finned tubes are commercially available.

For 92% engine efficiency, Aaronson's analysis shows that the binary cycle saves the equivalent cost of l-p steam turbines and surface condensers in steam cycles.




**STEAM-PAYON-12 CYCLE** uses backpressure turbine for steam cycle exhausting into Payon-12 boiler and superheater. An 8-mw Payon-liquid-heating steam turbine works in tandem with 50-mw Payon-12 turbine of single-wheel radial-flow design. Payon-12 has high backpressure for ambient condensing-water temperatures available most times




**FLASH EVAPORATOR** takes steam from first extraction point, sends makeup to condenser. Blowdown keeps solids below scaling level

# FLASH EVAPORATOR ...competes with demineralizer for feedwater treatment

**Demineralizing high-pressure boiler makeup is common practice in today's power plant. But now flash evaporation, spurred by world-wide interest in sea-water conversion, is making a strong bid to challenge dominance of demineralizing in this critical treatment area.**

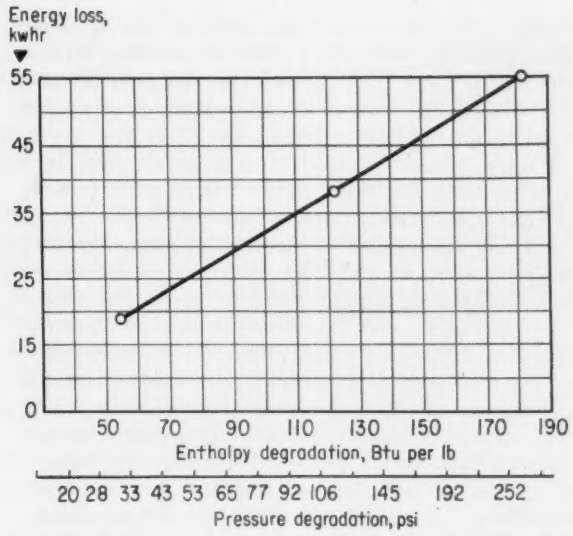
Flash evaporation is basically a simple process. Warm or hot water under pressure is sprayed into a lower-temperature and -pressure flash chamber. Part of the incoming water immediately flashes into vapor and is condensed to form pure distillate.

**Typical power cycle,** above, shows one way of incorporating a single-stage flash evaporator for makeup treatment. Raw water enters the flash chamber through a small heat exchanger warmed by drips from the evaporator heater. It joins the recycle (or brine) stream and enters an evaporator heater fed by steam from the first turbine extraction point. Heated brine then sprays into the flash evaporator which operates under partial vacuum. Resulting flashed steam leaves through a special steam separator and enters the evaporator condenser. There it condenses by transferring its latent heat to condensate pumped from the main condenser. High-purity distillate discharges directly into main condenser or is pumped to storage. Blowdown from the recycle line keeps total dissolved solids well below scaling level.

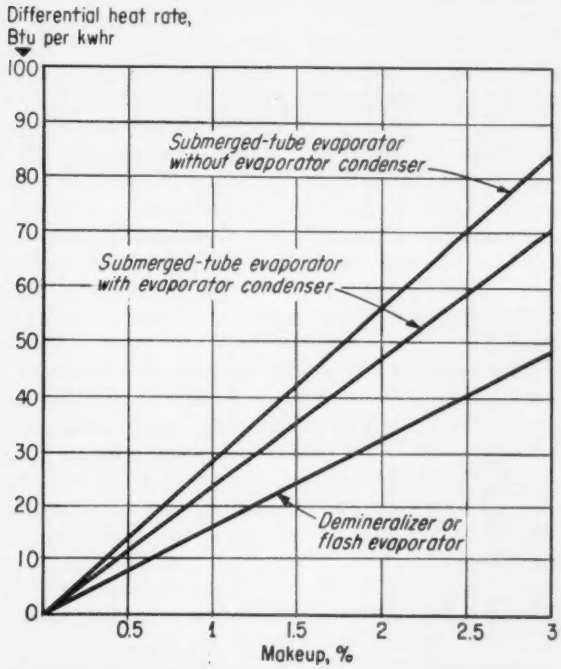
Flow diagram shows evaporator-heater drains entering evaporator condenser via an optional drain cooler on the makeup inlet. Alternately, the evaporator heater can drain to heater No. 1. This has added advantage of keeping good condensate isolated until distillate is checked for purity. Some systems cascade heater drains; others pump them forward. Each cycle must be designed on its own merits at any given location.

**Advantages** of this new flash-evaporator arrangement are readily spotted. First, the heat transfer involves condensing rather than boiling—low temperature differences can be used, still maintaining high heat-transfer rates. Scaling problems drop to a minimum because vaporization does not take place at the heat-transfer surface of the evaporator heater.

Second, there is a significant improvement in heat rate compared to the submerged-tube-evaporator hookup. All energy in the steam extracted by the flash evaporator returns to the regenerative cycle with no steam-pressure degradation. The flash evaporator precedes heater No. 1




**ENERGY LOSS** per 1000 lb of evaporated makeup, above, varies with steam-pressure drop across evaporator tubes in normal cycle[1]




**DIFFERENTIAL HEAT RATE** for evaporated makeup is cut by flash-evaporator hookup to level obtained with demineralized water[2]

and receives steam in parallel with it. Enough steam is extracted from the turbine by this combination to increase condensate temperature the required amount. From the standpoint of heat balance this puts flash-evaporated makeup on a par with demineralized water. Curves, above, illustrate improved heat rate, comparing flash evaporators and demineralizers with submerged-tube evaporators at full-load operation with varying makeup.

**Pioneer installation** at Richmond Station of Philadelphia Electric Co is a 12-stage vertical unit with 50,000-lb-per-hr capacity. Steam consumption of 7700 lb per hr produces 6.5-lb distillate per lb of steam at this station.

This evaporator is not part of the regenerative steam cycle; it is designed to operate independently of power-station load, since Richmond is not on base-load service. Low-pressure steam is supplied continuously from their power plant. Under these conditions, economics dictated a 12-stage cycle to minimize overall cost of water production. Design is based on a purity guarantee of 0.5 ppm with 3000-ppm shell concentration. The evaporator meets this easily; early problems with iron, copper and carbon dioxide have been resolved satisfactorily.

**Design advances** make it possible to construct flash evaporators for high, sustained efficiency at low unit cost. For example, multistage units can be constructed within a single steel shell. Another technique: put the low-pressure-stage heaters directly in the flash-evaporator package. Complete unit can be placed under the low-pressure turbine and extraction steam taken directly from the turbine casing with minimum intermediate piping.

Although many flash evaporators have been sold for high-pressure boiler makeup, very little operating data is available. But pilot-plant installations show that purity below 0.05-ppm total dissolved solids can be obtained with oxygen and carbon dioxide essentially zero. This is pure enough for high-pressure boiler makeup.

**Demineralizing has come of age** during the past ten years. Initial advantage of improved heat rate compared to submerged-tube evaporators did accelerate the trend away from evaporated makeup. But demineralized water has other important advantages that still hold good,

## What about using the power cycle to make potable water?

Best average heat rate for 1960 is just under 9000 Btu per kwhr—at the Clinch River Plant of Appalachian Power Company. This is still far from the theoretical energy-conversion figure of 3413 Btu per kwhr. Big loss is the latent heat of low-pressure steam removed in the surface condenser and sent to waste. But flash evaporators are now available to produce potable water from this low-level heat source. Why not team up the steam-power cycle with potable-water production in water-short areas? Bechtel Corp has already designed a sea-water-conversion plant of this type for Vicorp in the Virgin Islands. Potable water will be produced by multistage flash evaporation employing extraction steam from a 3000-kw turbine-generator. Utilities should consider feasibility and economics of making potable water as a byproduct of steam power. One profitable arrangement might be to contract with existing water companies to handle storage, distribution and sale.

even though flash-evaporator hookup cuts into the heat-balance edge: First, high-quality water is available for startup without the headaches associated with trucking in water or using a donkey boiler to furnish steam for evaporators. Demineralized water is always handy for cleaning, flushing and filling the boiler and boiler systems. And this high-quality water is available even though plant is shut down; it's produced independently of power-plant electrical production or load on the turbine.

**Economics** play an important role in the choice between flash evaporation and demineralization. Total annual cost of producing makeup by either method varies with (1) size and type installation (2) character of the raw water supply and (3) plant load factor.

One recent study indicates that the annual cost for flash evaporation is lower than demineralizing on water containing more than 500-ppm total dissolved solids. But the dividing line wavers with each installation. Fuel, chemical and capital-equipment costs may vary enough to justify installation of a flash evaporator on water containing dissolved solids in the range of 100 to 200 ppm. This is actually the case at Richmond Station.

**Need for pretreatment** is also a factor in any comparison of these two systems. Surface waters call for settling and filtration to remove turbidity prior to demineralization. It is possible that flash evaporators may not need any form of pretreatment. Tests are now under way to find out how high the brine dissolved-solids concentration can go without running into scale and corrosion problems. Preliminary lab work indicates that this level can go up to 1000 ppm without difficulty, but concensus is still that some form of evaporator pretreatment is needed for trouble-free operation.

**What's ahead?** Flash-evaporator development is a big advance in the treatment of makeup water suitable for high-pressure steam-power plants. But demineralizing is still very much a part of the overall picture. It's clear that generalizations and rules of thumb do not apply. Each case must be considered strictly on its own merits.

To minimize the cost of water production, an economic study should be made for each proposed installation based on: (1) total cost of fuel for steam and electric energy for pumping (2) other operating costs including labor, water, chemicals, maintenance and (3) capital charges.

Supercritical power plants who polish their condensate, using filters and demineralizers, may find it easy to justify evaporators. Condensate demineralizers are then already on hand for startup, shutdown. In an emergency they can operate to provide makeup independent of the power cycle. This combination is already used by several large utilities and will see increased use.

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Curves on p 151 are taken from:

1. Yoder, J D, "Demineralization compared with evaporation of makeup for surface-condensing power plants." Midwest Power Conference, 1950
2. Colt, R L, "Flash evaporators for the electric-utility industry." **Proceedings** of the American Power Conference, 1960, Volume XXII

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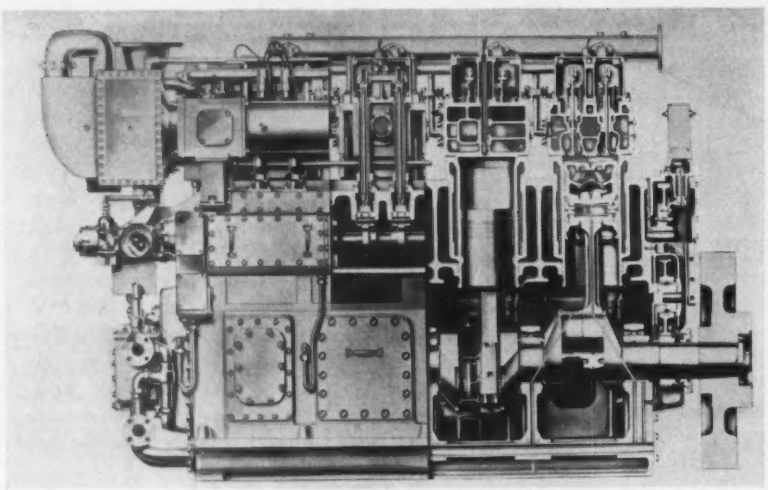


**TURBOCHARGED GAS ENGINE** arranged for spark ignition is readily adapted for straight diesel operation or as a dual-fuel engine using pilot oil for ignition

# OIL, GAS ENGINES move ahead in hp, mep and fuel flexibility

**Progress in oil- and gas-engine technology is advancing steadily along many lines. Available horsepower is growing and improved engine design ups mean effective pressure (mep). Fuel flexibility is another area where real progress is being made,** while use of solid-state equipment brings about an improvement in automatic control.

As available horsepowers grow, power engines in

creasingly overlap with gas-turbine generators. Diesel power units evaluate into the picture on the basis of operating efficiency: efficiencies of 40% for diesel power units stack up favorably against 17% for simple gas turbines and 25% for the more complex designs (of course, first cost of diesels will be higher).

**Mean effective pressures** are increasing all along the line. POWER editors recently watched a 16-cylinder oil engine running at an mep well over 210 psi. There was absolutely no exhaust smoke; as a matter of fact it was impossible to tell which of the several exhaust stacks on the test facility was actually in use. Consulting engineers and users will learn to accept these higher-mep machines, to garner their other advantages.

**Turbocharging** of 2- and 4-cycle engines is becoming more and more common. There are two basic approaches here. The first involves a constant exhaust-gas flow, headered from all cylinders to turbocharger drive impeller. But unless separate compressed-air jets are used during startup, this turbocharging cannot take over much below 50% unit load.

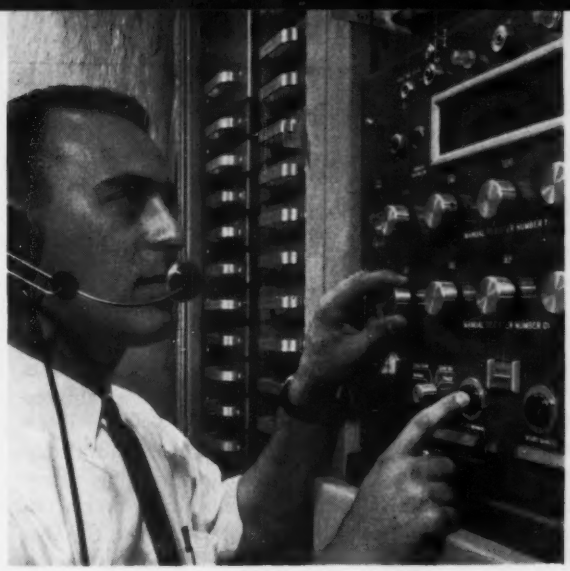
Second type is pulse-driven. Here exhaust from individual cylinders or groups of cylinders is piped directly to the turbocharger. Then the impeller is driven by a timed series of pulses rather than a continuous exhaust-gas flow. In this arrangement, the turbocharger can take over at about 25% load—but two separate turbochargers may be needed in larger units.

**Fuel flexibility** is on the increase. A new small production-line diesel engine (20 to 650 hp), recently announced, runs on anything from No. 2 fuel oil to aviation gasoline. The secret is an improved needle-valve-controlled injector and compression ratio upped from 17.5:1 to 23:1. Right now, applications are purely military, but in many industrial situations, too, this flexibility can pay off.

Dual-fuel dual-ignition engines are getting more attention. They run either as straight oil-fired diesel engines, pilot-oil-fired gas engines or spark-fired gas engines. Dual-fuel engines, of course, have been around for a long time. But now the addition of spark-fired gas ignition in the same basic engine increases flexibility and permits pure gas operation. To make this conversion you merely remove the injection valve and substitute a spark plug. This engine type is most favorable where you anticipate firm gas at some time in the future or where long periods of straight gas operation are economically favorable because of relative fuel costs.

**Automatic control** of startup, variable-load and steady-load operation and shutdown makes power engines reliable in remote locations. Eliminating the human factor ups safety and reliability, even where manual operation would otherwise be possible.

A variety of safety measures can be built in. They'll sense whether startup is successful, and if it isn't, either signal an alarm or recycle the startup sequence. During operation, controls sense many items—high jacket-water temperature, high exhaust temperature, engine vibration, low fuel pressure, engine overspeed. Off-normal conditions either actuate an alarm or shut down the engine, depending on type of condition and its severity. Control system might also operate a data logger to produce a continuous record of engine operating characteristics, trends.



**DIGITAL-COMPUTER-DIRECTED CONTROL** at Philadelphia Electric loads all generators on the basis of minimum incremental cost

# COMPUTER CONTROL ...starts up at Philadelphia Electric

**Take some three dozen turbine-generators at nine different stations, steam and hydro mixed, and assign to each one, automatically and continuously, the exact amount of power it is to supply for minimum incremental cost.** That's what the Philadelphia Electric Company expects of the digital-computer-directed control system they recently placed in operation. By the end of this year, most of the 34 generating units at nine power stations—27 driven by steam turbines and, at Conowingo Dam on the Susquehanna River in Maryland, seven by water—will be under automatic load control of the computer-directed system.

In addition to the computer itself, the automatic dispatching system consists of these other basic parts: individual load-frequency-control systems for each of 15 separate command channels; peripheral equipment linking computer to control system, including a console from which Philadelphia Electric's power directors operate and supervise the power system; telemetering equipment that transmits commands to the nine generating stations. The whole system, except station controls, is located at the utility's headquarters in mid-city Philadelphia.

**Equipment operates at high speeds.** It adds and subtracts, for example, in 0.14 milliseconds, completes square-root extractions in 2.6 milliseconds. This speed is made possible by a parallel operation, because the computer has two memories. A magnetic-core memory provides access time of 20 milliseconds and a 4096-word capacity, while an auxiliary drum memory can store 8192 words and get at them in 17 milliseconds flat. **continued**

Advantages of both types are combined; that is, random accessibility and fast access and program permanence. At the programer's disposal are 76 basic commands, many of them performing a mutiplicity of orders. One command per word is all that the computer's single-address-instruction system requires.

**Here's how** this computer-directed control system works: Once the total generation level is determined and initial allocations are made to controlled generating units, the computer takes over. It samples desired steam generation every ten seconds, calculates new economic allocations and sets these values sequentially on control amplifiers to obtain the most economical loading. These differential amplifiers hold a constant output, thus acting as fail-safe memory devices if control is interrupted. Then they in turn control turbine-governor actuators so that generators are loaded in accordance with the computer's command signal. Each of the nine stations has its own consoles, and from them operators can set high and low load limits for the generating units, as well as rate of change in generation. In effect, these settings limit commands that the central computer can give its individual generating stations.

**To make economic dispatch calculations,** computer bases its computations on incremental production cost curves, fuel costs, performance characteristics of each controlled generating unit, incremental transmission losses, all programed information, and input variables which it reads continuously. So that the computer can synchronize itself with system conditions, these variables include total assigned steam generation, manually controlled steam units, hydro generation, interconnecting tie-line power flow and steam units available for allocation.

This is the first instance of a process-designed digital computer performing a control function and figuring billing on a time-sharing basis. It is a step towards what the manufacturer, Minneapolis-Honeywell Regulator Company, foresees as an eventual marriage: company-wide plant and office-operation automation. And in addition, it is the first solid-state-computer-oriented automatic dispatching system. There are no motors, servos, slidewires or vacuum tubes. Only moving parts are mercury-wetted relays in the computer's multiplexing units.

Philadelphia Electric expects their new control system to provide these five benefits: (1) economical incremental loading of controlled units (2) improved response of generating units to load changes (3) continuous determination of system transmission losses (4) for billing purposes, cost data on the amount of power exchanged between Philadelphia Electric and the Pennsylvania-New Jersey-Maryland Interconnection (5) off-line system studies, including maintenance scheduling.

## Pumped-storage plants in North America

| Owner and plant | Capacity, kw | Turbine head, ft | Type of unit** | Starting date |
|---|---|---|---|---|
| Connecticut Light and Power Co | 1—24,000 | 226 | Gen | 1929 |
| Rocky River, Conn. | 2—3500 | 226 | Rev | 1929 |
| Lower Colorado River Authority | 3—11,250 | 133 to 73 | Gen | 1938, 1950 |
| Buchanan, Texas | 1—Pump* | 133 to 73 | Pump | 1950 |
| U. S. Dept of Interior, Bur Reclam | 2—31,500 | 1055 | Gen | 1954 |
| Flatiron, Colo. | 1—8500 | 250 | Rev | 1954 |
| Tennessee Valley Authority | 1—57,600 | 190 | Gen | 1940 |
| Hiwassee, N. C. | 1—59,500 | 190 | Rev | 1956 |
| Hydro-Electric Power Comm of Ont. | 16—72,000 | 292 | Gen | 1954 |
| Sir Adam Beck—Niagara No. 2 | 6—27,900 | 83 | Rev | 1957 |
| Power Authority of State of N. Y. | | | | |
| Tuscarora, N. Y. (Niagara Falls) | 12—20,000 | 75 | Rev | 1963 |
| Appalachian Power Company | 2—140,000 | 179 | Gen | 1964 |
| Smith Mountain, Va. | 2—60,000 | 180 | Rev | 1964 |
| Union Electric Company | | | | |
| Taum Sauk, Me. | 2—175,000 | 745 | Rev | 1962 |
| Public Service Co of Oklahoma | | | | |
| Sand Creek, Okla. | 4—50,000 | 235 | Rev | 1964 |

* Pump delivers water to carry one turbine installed in 1950

**Gen—conventional hydro generating unit; Rev—reversible pump-turbine unit

# HYDRO ...more peaking plants to come

**Growing loads on high-efficiency systems keep spurring the search for more economical methods of generating system peak demands. Latest is the Yards Creek Storage project to be built in Blairstown Township of New Jersey** by the Jersey Central Power & Light Co. The 300-mw pumped-storage plant with 650-ft head will have an upper reservoir on Kittatinny Mountain and lower pool on Yards Creek near the Delaware River, each with about 4650 acre-ft usable storage. Upper pool will be formed by a rock-fill dam and dikes about 1¾-miles long. Lower pool will have an earth-fill dam, 55-ft high and ¼-mile long; 100-ft-long spillway; earth-fill dike 2000-ft long and an auxiliary dam. Plant may be ready by end of 1964.

# NUCLEAR PLANTS ...reach for the future

**U. S. Army Nuclear Power Program** has led the way in developing small nuclear plants. These are classed as stationary, *S*, portable, *P*, or mobile, *M*. Here's what they've done so far:

**Pressurized-water plants**

| *Plant* | *SM-1* | *SM-1A* | *PM-2A* | *SM-2* | *PM-1* |
|---|---|---|---|---|---|
| Output, mwt | 10 | 20 | 10 | 28 | 10.3 |
| Life, mwyr | 15 | 15 | 8 | 28 | 18.7 |
| Press, psig | 1200 | 1200 | 1750 | 2000 | 1300 |
| Temp, F | 440 | 434 | 509 | 515 | 483 |
| Flow, gpm | 3960 | 7050 | 4220 | 7800 | 2125 |
| No. elements | 45 | 45 | 37 | 45 | 6 |
| U-235, kg | 22.4 | 22.4 | 19.5 | 36.2 | 28.3 |
| No. cont rods | 7 | 7 | 5 | 7 | 6 |
| Power, kw per liter | 72 | 144 | 87 | 200 | 50 |
| Weight, tons | 2500 | 3000 | 310 | — | 225 |

**Boiling-water plants**

| *Plant* | *SL-1* | *PL-1* | *PL-2* |
|---|---|---|---|
| Output, mwt | 3 | 3.6 | 8.2 |
| Life, mwyr | 6.3 | 30 | 30 |
| Press, psig | 300 | 600 | 600 |
| Temp, F | 422 | 489 | 489 |
| Flow, lb per hr | 9020 | 11,794 | 25,980 |
| No. elements | 40 | 24 | 24 |
| U-235, kg | 14 | 67 | 67 |
| No. cont rods | 5 | 9 | 9 |
| Power, kw per liter | 9.2 | 5.9 | 13.6 |
| Weight, tons | 250 | 84 | 101 |

**How have reactors behaved?** Reactors now running offer encouraging experience for future full-scale plants. Pressurized-water types can run either as base- or peak-load units on utility systems. Boiling-water types can run with low radioactivity in the turbine. Actual capacity has climbed higher than initial conservative estimates on current units. Availability factors have topped 90%. Major repairs can be made on radioactive systems, though costs run considerably higher than for conventional steam plants. Personnel radiation exposure has not exceeded AEC limits despite high radiation levels in some operating areas. They've made sure of this by developing special methods of confining contamination, increasing manpower effectiveness and by thoroughly decontaminating equipment. Radioactive wastes have been handled without any major difficulty. Liquid wastes are diluted before discharging; solid wastes are packaged; gaseous wastes discharge to atmosphere under control.

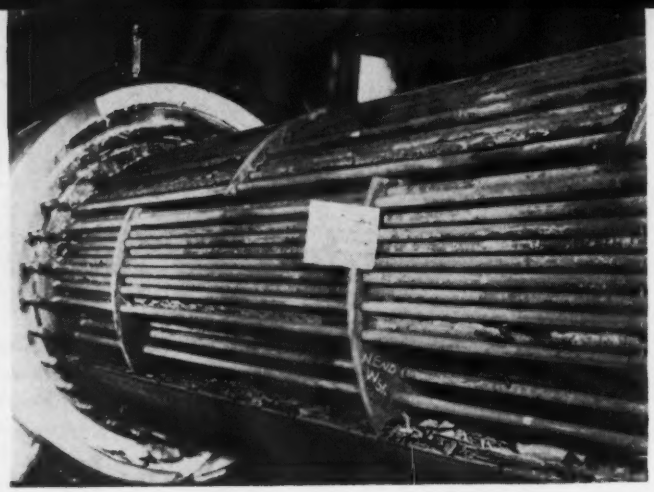
**Scratch one gas-cooled reactor;** the AEC has cancelled its contract with the East Central Nuclear Group and Florida West Coast Nuclear Group. These Groups were studying a 57-mwe heavy-water-moderated gas-cooled plant under the Power Demonstration Reactor Program, but decided that they could not make a commitment to build the plant until further development work had been completed. The AEC said it could not continue the contract without a commitment.

**Nuclear-fuel wastes** pose less of a disposal problem than ash from coal-fired plants, says T G Le Clair of General Atomic, Division of General Dynamics. Spent fuel from a 1000-mwe high-temperature gas-cooled reactor plant, accumulated for 30 years, can be stored in a ¼-acre vault 20-ft deep. Ashes from a coal-fired plant of the same size fill a volume 1000 times larger. Gas produced by fissioning can be handled more easily than sulfur dioxide from coal plants.

**Performance improvements** in nuclear plants point to competitive realization in the future. Second core for Shippingport raises reactor capacity 2½ times without increasing size of the pressure vessel. New core for Experimental Boiling Water Reactor raises capacity five times to 100 mwt. Power density of the Peach Bottom gas-cooled reactor will be about 20 times that of England's Calder Hall, first of the gas-cooled type. Development of nuclear superheating will let designers use full thermal efficiency of modern steam turbines for an important advance in economic advantage of nuclear power plants.

**Nuclear power's future** was forecast in a survey of opinions of 40 organizations (utilities, manufacturers and national laboratories) by T G Le Clair. Averaged out, the guesses are that fossil-fuel costs will rise by 12.9% in the next ten years while nuclear-fuel costs fall by 9.4% during the same period. This group expects a 2.9% rise in fossil-fuel-fired plants' thermal efficiency (that is, from 30.0 to 32.9) while nuclear plants rise by 4.5%. The proportion of new capacity installed that will be nuclear in 1965, 1970 and 1980 is estimated at 4%, 10% and 25%. Assuming an average annual capacity growth of 6.7%, proportions translate into these total nuclear capacities: 1.4-million kw in 1965, 5-million kw in 1970 and 45-million kw in 1980.

**Ultimate reactor design** may still be in the future. Despite the wide variety of reactor types now being studied, designed, erected and operated, there are others proposed that may offer most economical power. Ideas that have been advanced include: Beryllium-oxide moderation, boiling-sulfur cooling, epithermal-thorium conversion, fluidized fuel bed, gas suspension of fuel dust, mercury cooling, pebble fuel bed, spectral-shift control by varying proportion of light- and heavy-water moderator, steam cooling, variable amounts of moderator.



**FEEDWATER-HEATER TUBES** show exfoliation type of corrosion

# MATERIALS

## ...advance in the areas of high-temperature and corrosion-resistant alloys . . . tubing for heat exchangers

**Progress in plant and equipment design depends increasingly on development of improved alloys and gains in our knowledge of the behavior of materials under varying service conditions. Here are highlights of progress in these key areas:***

**A new nickel-base alloy** now in the field-trial stage promises long-time service at temperatures of 1200 F. Its rupture strength at that temperature runs 2 to 2½ times that of type 347 stainless steel. Tests indicate excellent structural stability, and the retention of high ductility after long exposure to temperature and stress. IN-102 has its nickel base alloyed with 15% chromium to supply oxidation resistance; this matrix is further alloyed with solid-solution hardeners such as molybdenum, columbium and tungsten, table 1.

Present experience suggests that the welding and brazing response of IN-102 is good, but further work is being done to strengthen the weld deposit with larger amounts of hardener. While IN-102 was developed for the steam-plant field, particularly heavy-wall steam lines, superheater tubes, etc, it may also offer possibilities in the nuclear field since it is essentially cobalt-free.

New casting alloy, 713-C, is sold by a number of investment-casting producers under license from International Nickel Co. Developed for jet-engine blading, 713-C exhibits excellent stability after long exposure at temperatures of 1350 to 1700 F. (Table 1 lists composition.)

*As recently reported to the Conference on Metallic Materials for Conventional and Nuclear Power Plant Applications sponsored by International Nickel Company, Inc and Denver Research Inst

**Stainless steel** in extra-low-carbon grades, such as 304L, has attractive features—but these are offset in some applications by low maximum-stress allowances. One reason for low allowances is the variability of high-temperature properties of alloys meeting the AISI standard composition limits. But recent research on the effects of small variations in amounts of residual elements such as columbium, boron, vanadium, titanium and aluminum indicates that careful control of chemical composition can raise the 1200-F rupture strength a sizable amount. Such an improvement can be of value both to producers and certain users of stainless steels.

**Fuel-oil-ash corrosion** in high-temperature units burning residual oils appears to result from vanadium, sodium and sulfur compounds in the ash. One approach to the problem has been treating the oil to remove or reduce these compounds. But cost of the treating operation keeps this from being a general solution. Another possible approach, the application of protective coatings, runs into problems with high temperatures and particularly with the difficulty of maintaining adherence under often severe temperature cycling. Additives to raise the fusion point of the ash meet with some success in gas-turbine practice and central-station boilers. Magnesium shows particular promise; in oxide or sulfate form, it's added to the oil as a very fine powder of controlled particle size or as an aqueous suspension. In usual practice the ratio between magnesium and vanadium in the ash runs about 3:1.

Direct solution to the problem lies, of course, in finding alloys to withstand this particular attack while keeping other necessary properties. Extensive laboratory and service tests indicate that higher chromium content in heat-resistant alloys increases their resistance to fuel-oil-ash corrosion. A recently developed 60Cr-40Ni alloy appears to offer considerable promise under these conditions.

**Stainless-steel condenser tubing** gets increasing attention, both for sections of condensers where conditions are severe and for entire condensers, should water characteristics warrant. Table 2 lists 25 central stations where stainless-steel tubing is now in use or being contemplated to solve specific problems.

Because of their ability to resist erosion, stainless-steel tubes are used in areas of the condenser where impinge-

## 1—Nominal compositions of two new nickel-base alloys

| | IN-102 | 713-C |
|---|---|---|
| Chromium | 15 | 13 |
| Iron | 7 | — |
| Molybdenum | 3 | 4.5 |
| Columbium | 3 | 2 |
| Tungsten | 3 | — |
| Aluminum | 0.5 | 6 |
| Titanium | 0.5 | 0.6 |
| Carbon | 0.06 | 0.13 |
| Zirconium | — | 0.10 |
| Boron | — | 0.01 |
| Nickel | Balance | Balance |

## 2—These stations use or are considering stainless condenser tubes

| Company | Station | Approximate linear ft |
|---|---|---|
| Monongahela Power | Rivesville | 370,000 |
| Duquesne Light | Elrama | 750,000 |
| Pennsylvania Electric | Shawville | 1,220,000 |
| West Penn Power | Mitchell | 440,000 |
| United Illuminating | English | 110,000 |
| Delaware Power & Light | Edge Moor | 88,000 |
| Monongahela Power | Albright | 16,000 |
| Commonwealth Edison | Joliet | 40,000 |
| Commonwealth Edison | Waukegan | 17,000 |
| Wisconsin Electric | Oak Creek | 30,000 |
| Kansas City Power & Light | Montrose | 15,000 |
| Louisiana Power & Light | Nine Mile Point | 18,000 |
| Electric Energy | Joppa | 60,000 |
| Dayton Power & Light | Tait | 19,000 |
| Niagara Mohawk | Dunkirk | 36,000 |
| Niagara Mohawk | Huntley | 36,000 |
| Cleveland Electric Illuminating | Lake Shore | 25,000 |
| Baltimore Gas & Electric | C P Crane | 60,000 |
| West Penn Power | Armstrong | 3000 |
| Southern California Edison | Mandalay | 9000 |
| Sao Paulo, Brazil | | 59,000 |
| Columbus & Southern Ohio | Conesville | 37,000 |
| American Electric Power | Tanner's Creek | 76,000 |
| Carolina Power & Light | Goldsboro | 57,000 |
| Arizona Public Service | Cholla | 30,000 |

ment of wet exhaust steam can occur—the exhaust inlet area, for example. In many cases, stainless steel is applied in the air-cooler section because of its high resistance to corrosion by noncondensable gases such as oxygen, carbon dioxide and ammonia.

Basic interest in stainless for the main tube bank stems from its general ability to withstand cooling-water corrosion and erosion, especially under severe conditions. In addition, resistance to fouling often means continued high cleanliness factors and less tube cleaning. And stainless tubing can have thinner walls, resulting in greater internal diameters; coupled, these last two factors increase water flow for the same pumping power.

Initial concern over heat-transfer properties of stainless has virtually disappeared as experience and field-test data accumulated. Relatively poor thermal conductivity of the metal itself is offset substantially by the better film coefficients resulting from less fouling. While more work needs to be done toward establishing precise values to be assigned to stainless, it is evident that in condenser service, its overall heat-transfer characteristics come close to those of admiralty metal; they are not much poorer, as was believed originally. This indicates that existing condensers can be retubed with stainless steel without losing their efficiency.

Interesting possibilities are on the horizon for condensers designed from the ground up to use stainless. While the economics of increased pumping power is debated, fact remains that higher water velocities can mean substantial reductions in unit size in an area where space limitations are growing more serious.

Of the 30 different grades of welded stainless-steel tubing, two prove most generally suitable for condenser service. Type 304 is an excellent general-purpose stainless. Used in many fresh-water areas, it shows good resistance to contaminated waters. Type 316 is often selected for brackish or sea-water installations.

**Feedwater-heater-tube failures** have recently been reported by plants in the U.S. and abroad. This has resulted from a severe corrosion attack on the steam side of h-p heaters, photo. Characteristically, a dark-gray-black scale forms and flakes off—hence the attack is called *exfoliation*. Reduced wall thickness leads to rupture.

Tube failures of this type occur mainly in units in peaking service, with relatively frequent startups and shutdowns. Studies in the United Kingdom and in Japan indicate that the most severe attack occurs in the final h-p heater, usually in the presence of condensate and always when oxygen got into the heater shell during shutdown. Oxygen scavenger type did not seem a factor.

Exfoliation attack has occurred most frequently on 70-30 copper-nickel tubes, to a lesser extent on 80-20 tubes. The 90-10 alloy generally has been free from attack. Laboratory investigations tend to confirm studies of field failures and indicate the possibility of improving 70-30 alloys. Separate additions of iron, manganese, silicon and beryllium increase the resistance of 70-30 to exfoliation—there is some evidence that varying the manganese content even within the limits set by ASTM specifications for commercial 70-30 alloys will improve resistance. Tests also confirm that the 80-20 and 90-10 alloys are relatively more resistant than 70-30, while monel is immune to exfoliation.

Direct counterattack to exfoliation at the present time would be to use tube materials that are immune, such as monel or Inconel. But exfoliation occurs mainly in peak-load units, making it difficult to justify higher-cost materials. In some plants, steam blanketing and careful control of conditions during shutdown has proved effective. Also, tests are under way on filming inhibitors for continuous feed. Aim: secure benefits during operation and produce a film to last during short shutdowns.

# COMPUTERS IN PLANTS...now fact, not theory

**Past issues of *Power* described computers in central-station control and monitoring. Now we summarize information on announced systems. The picture of utility automation found below is one of conservative progress toward full plant control.** Several systems instrument all plants so that a future, more sophisticated approach to economic dispatch can use dynamic unit cost data. Crawl-before-you-walk attitude is demonstrated by the preponderance of data-logging performance-monitoring applications. Of the 34 units listed, 6 are data loggers and 19 performance monitors. Five units include automatic start or stop control but revert to performance monitoring in normal operation. One application combines performance monitoring with noninteracting adaptive control of the steam generator.

**The cold, hard facts** of utility operation appear in input- and output-signal estimates. Data loggers usually tie to 100 to 200 inputs, do little contact sensing. Signal totals jump for performance monitors; because they work as alarms, totals may climb above 1000. Start-stop or full computing control can require over 2000 inputs. Added complexity does little to basic computer-section cost, but the extra instrumentation for inputs and outputs costs around $1-million per unit.

For most utility engineers, justification of full control will be easier after data loggers and performance monitors have helped analyze and define dynamics of our complex modern central-station cycles.

## Survey of on-line computer use by plants shows conservative planning

| Utility | Location | Plant name | Manufacturer | System type | System function | Signal: Inputs: Analog | Inputs: Digital | Inputs: Contact | Outputs: Analog | Outputs: Logged items | Outputs: Digital |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Arizona Public Service Co | Holbrook, Ariz. | Cholla | GE | D | PM | 375 | | 100 | 4 | | 217 |
| Boston Edison Co | Boston, Mass. | Mystic | ISI | D | PM | 540 | 16 | | | 264 | |
| Carolina Power & Light Co | Hartsville, S. C. | H B Robinson | D | D | PM | 384 | 6 | 32 | 5 | 100 | 64 |
| Carolina Power & Light Co | Goldsboro, N. C. | Goldsboro | D | AD | C | 1024 | 32 | 1344 | 64 | 110 | 700 |
| City of Memphis | Memphis, Tenn. | T H Allen | BM | D | PM | 856 | | | | 856 | |
| Duquesne Light Co | Shippingport, Pa. | Shippingport | D | D | PM | 250 | | | | 400 | |
| Georgia Power Co | Atlanta, Ga. | McDonough | GE,H | AD | PM* | 680 | | 750 | 18 | | 86 |
| Gulf States Utilities Co | Orange County, Texas | Sabine | BM | D | PM | 445 | | | | 470 | |
| Gulf States Utilities Co | Willow Glen, La. | Willow Glen | D | D | PM | 350 | | | | 145 | |
| Gulf States Utilities Co | Lake Charles, La. | Riverside | RCA | D | SS | 200 | | 200 | | | |
| Kansas Gas & Electric Co | Wichita, Kansas | Gordon Evans | D | D | PM | 384 | 16 | 64 | 5 | 108 | 64 |
| Louisiana Power & Light Co | Sterlington, La. | Sterlington | D | D | PM | 338 | 18 | | | 117 | 6 |
| Louisiana Power & Light Co | La Place, La. | Little Gypsy | D | AD | C | 576 | 16 | 740 | 16 | 110 | 448 |
| New England Electric Power Co | Somerset, Mass. | Brayton Point | RCA | D | PM | 1100 | | | | | |
| New York State Electric & Gas Co | Ludlowville, N. Y. | Milliken | BM | D | DL | 348 | | | | 348 | |
| Northern Indiana Public Service | Baileytown, Ind. | Bailley | LN | D | DL | 400 | | | | 400 | |
| Public Service Electric & Gas Co | Jersey City, N. J. | Hudson | WE | D | C | | | | | | |
| Public Service Electric & Gas Co | Sewaren, N. J. | Sewaren | WE | D | SS | 1024 | 5 | 512 | | | |
| Public Service Electric & Gas Co | Bergen County, N. J. | Bergen | LN | D | PM | 1396 | | | | 196 | |
| Public Service Electric & Gas Co | Trenton, N. J. | Mercer | LN | D | PM | 1396 | | | | 196 | |
| Public Service Co of Oklahoma | Oologah, Okla. | Northeast | GE | D | PM | 472 | 22 | | | | |
| Public Utility District No. 1 | Chelan County, Wash. | Rocky Beach | BM | D | DL | 110 | | | | 110 | |
| Public Utility District No. 1 | Chelan County, Wash. | Rock Island | BM | D | DL | 125 | | | | 125 | |
| Puerto Rico Water Resources Auth | Puerto Rico | Palo Seco | GE | D | PM | 300 | | | | | |
| S. Carolina Electric & Gas Co | Columbia, S. C. | S McMeekin | MH | AD | DL | 103 | | 13 | | 78 | |
| S. Carolina Electric & Gas Co | Canadys, S. C. | Canadys | GE | D | PM | 176 | 414 | | 5 | | |
| Southern California Edison Co | Huntington Beach, Calif. | Huntington Beach | GE | D | SS | 870 | 824 | | 20 | | 632 |
| Southern California Edison Co | Los Angeles County, Calif. | Alamitos | GE | D | SS | 1102 | 1206 | | 20 | | 1100 |
| Southwestern Public Service Co | Amarillo, Texas | Nichols | BM | AD | PM | 163 | | | | 80 | |
| Tennessee Valley Authority | Bridgeport, Ala. | Widows Creek | H | AD | DL | 475 | | | | | |
| Tennessee Valley Authority | Tuscumbia, Ala. | Colbert | RW | D | PM | 600 | 36 | | 20 | | 80 |
| Tennessee Valley Authority | Drakesboro, Ky. | Paradise | RW | D | SS | 1130 | 400 | | 40 | | 400 |
| Texas Electric Service Co | Fort Worth, Texas | Handley | WE | D | PM | | | | | | |
| West Texas Utilities Co | Bronte, Texas | Oak Creek | BM | D | DL | 175 | | | | 175 | |

### Symbols used above

- D Digital computing
- AD Combination digital-analog computing
- DL Data logging, including alarm scanning
- PM Performance monitoring
- SS Start-stop control, performance monitoring
- CC Computer control of full operation
- BM The Bailey Meter Co
- D Daystrom, Control Systems Div
- GE General Electric Co
- H Hagan Chemical & Control Co
- ISI Information Systems Inc
- LN Leeds & Northrup Co
- MH Minneapolis-Honeywell Regulator Co
- RCA Radio Corporation of America
- TRW TRW Computers Co
- WE Westinghouse Electric Corp
- * Noninteracting adaptive control

**Power**
OCTOBER

# 1961

# Central Station Design Survey

- Details of 75 central-station steam plants
- Design data on 78 hydroelectric installations

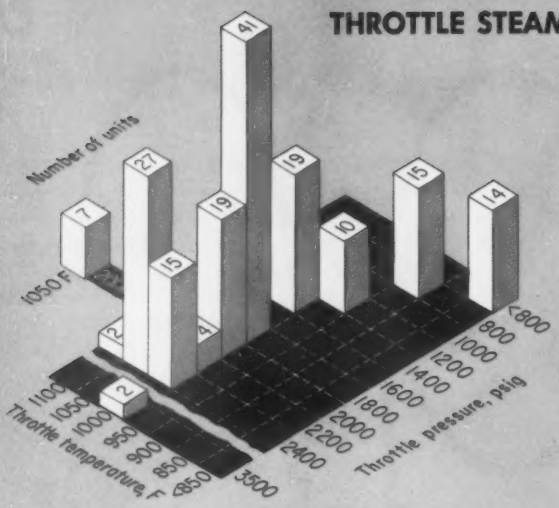
This year's survey brings you the widely awaited tabulation of hydroelectric plants, now compiled on a triennial schedule. The hydro table includes plants with units just started, under construction or planned since 1958. Each of the two hydro tables takes up two pages of pertinent data, and you'll find them following POWER's annual tabulation of new central-station steam-plant projects. Design features of steam plants fill four tightly packed pages.

**What the tables mean:** We feel that information listed here is the most complete that can be had. But because of the way we must collect the facts, the survey of generating plants does not include *all* current programs, nor does it contain *only* current plant construction.

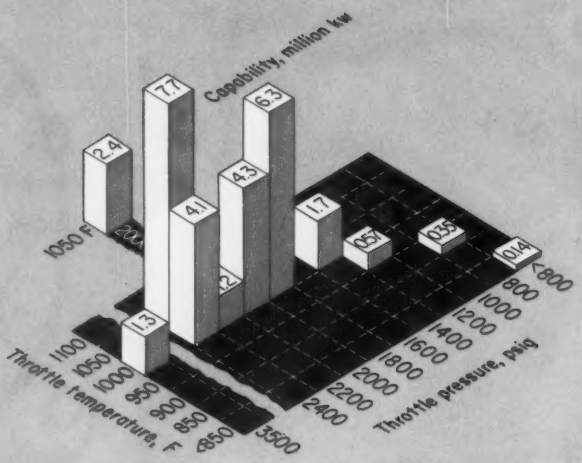
We work from published lists of planned installations in organizing our survey. Questionnaires asking for project details are sent to individual utilities, governmental groups and municipalities on these lists. The data we receive from these organizations ranges from construction planned for well in the future to plants that are now running.

Being representative of design and construction practice in late 1960 and early '61, the steam-plant and hydro tables give useful information on general trends. But you can see that they can't be complete. So just consider them as extensive samples. Don't use them to get total values, or make comparisons where incompleteness might seriously distort results.

## THROTTLE STEAM CONDITIONS

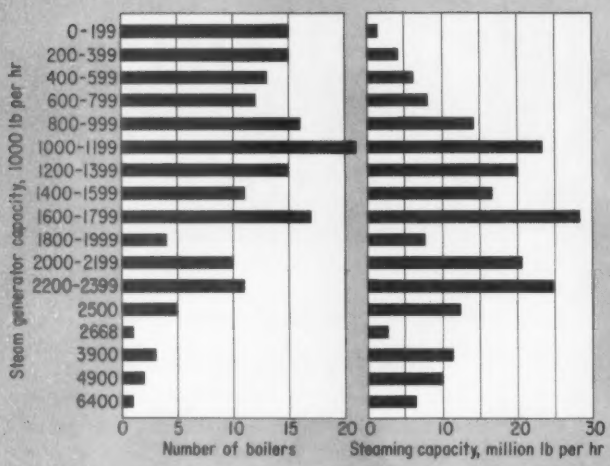



THROTTLE STEAM CONDITIONS of 2000 psig and higher will be used by about 43% of the new units being built for 1961 start and later

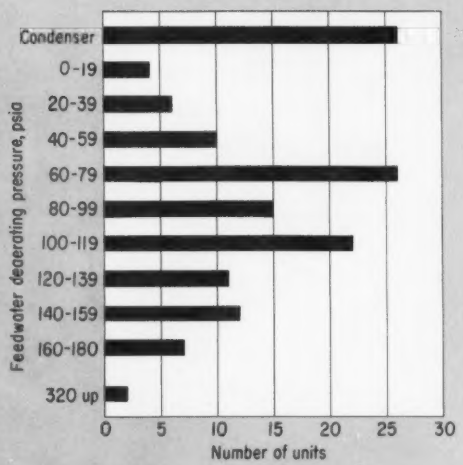



TURBINE CAPABILITY concentrates on high-steam-condition end of chart; 70% of total capability will use steam at 2000 psig or higher

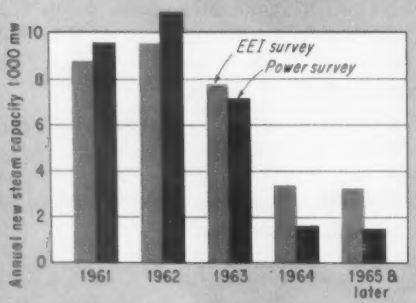
# Trends in CENTRAL STATIONS



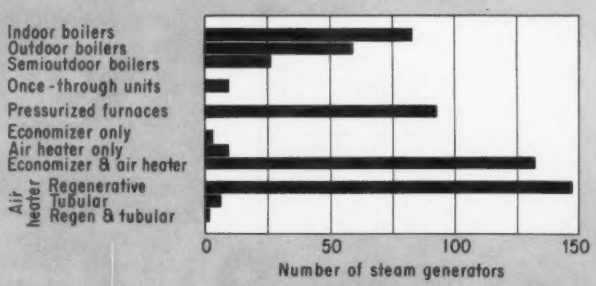

STEAM-GENERATOR RATINGS for 1961 start and later show more large units than in 1960 survey; 1600 group now has largest total




FEEDWATER DEAERATING PRESSURES concentrate in the middle range as in past surveys, but more condenser hotwell deaeration is used

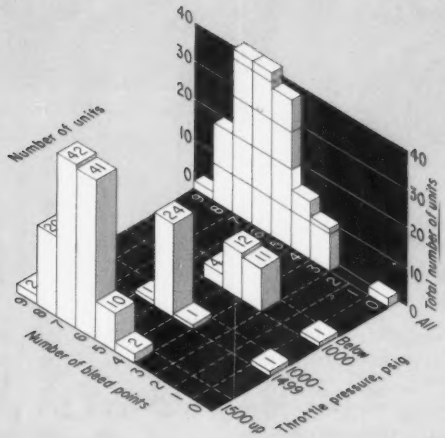



POWER SURVEYS in this and previous reports cover approximately 94% of 32.7-million-kw steam-plant capability planned for 1961-65



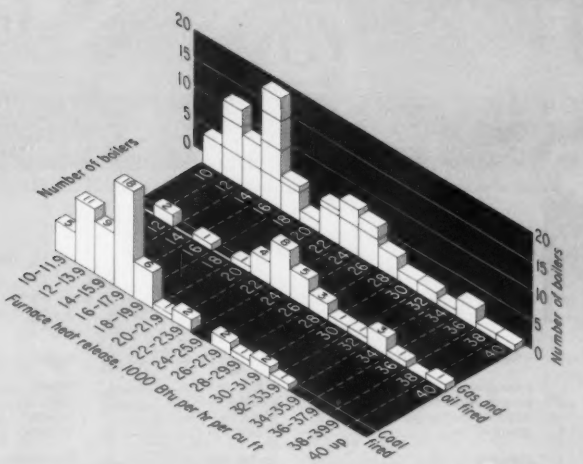

STEAM-GENERATOR FEATURES show steadily growing use of all heat-recovery equipment and more applications of once-through units

## BLEED POINTS

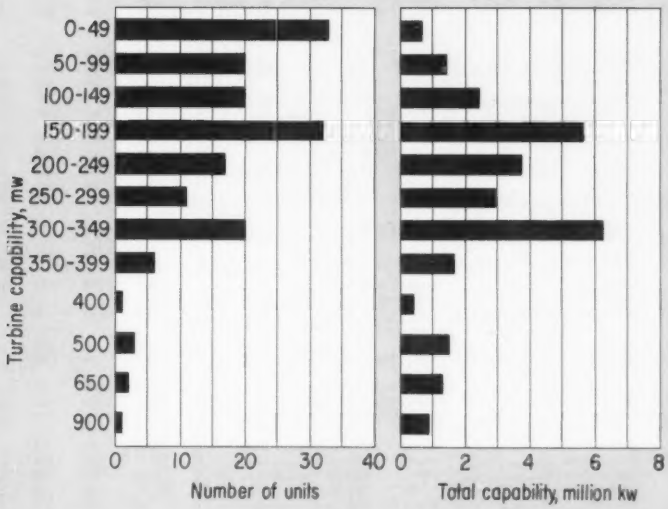



**SIX AND SEVEN BLEED POINTS** still predominate in regenerative cycles. But most units under 1500 psig have five bleed points or less

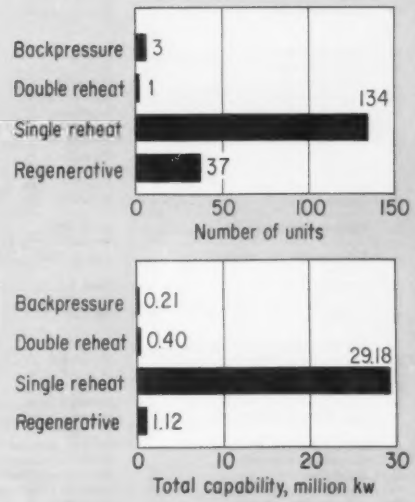
## HEAT RELEASE



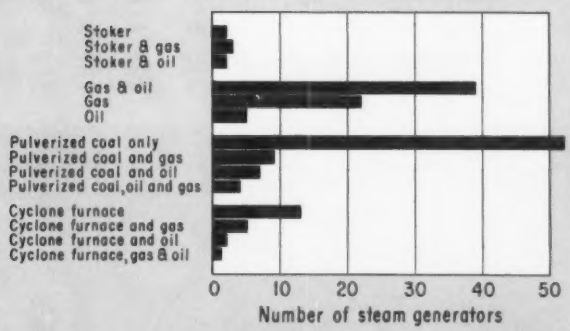

**FURNACE HEAT-RELEASE RATES** below 20,000 Btu cover 84% of the coal-fired units while over 20,000 cover 87% of gas and oil units



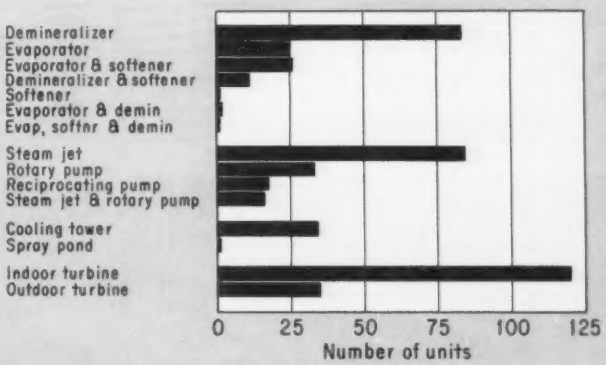

**TURBINE CAPABILITIES** and number of units show a decrease in smaller units, while the average capacity has grown from 164 mw in 1960 survey to 173 mw for 1961 and later




**REHEAT TURBINES** comprise 95% of all capacity planned, have an average size of 219 mw




**FIRING EQUIPMENT** emphasizes the use of coal as principal fuel by the utility industry, but gas ranks as an important secondary fuel




**STATION FEATURES** highlight popularity of indoor steam-turbine installations and the use of demineralizers for feedwater treatment

# Table 1

# 1961 design survey of typical

Note that each listing covers four pages. The project number helps you keep track of a specific installation after you turn the facing page

| Project Number | Company | Location | Plant Name | Consulting Engineers | Unit No., new unit | First operation, new unit | Throttle pressure, psig | Steam temperature F | | Number | Capacity each, 1000 lb per hr |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Throttle | Reheat | | |
| 1 | Public Service Electric and Gas Co | Jersey City, N J | Hudson | | 1 | 3-65 | 3500 | 1000 | 1025<br>1050 | 1[1,13] | 2450 |
| 2 | Metropolitan Edison Co | Portland, Pa | Portland | Gilbert Associates Inc | 2 | 4-62 | 2520 | 1050 | 1000 | 1[2] | 1700 |
| 3 | Northern Indiana Public Service Co | Baileytown, Ind | Bailly | Sargent & Lundy | 7[3] | 12-62 | 2400 | 1000 | 1000 | 1 | 1200 |
| 4 | Northern States Power Co | Minneapolis, Minn | Riverside | Pioneer Svc and Engrg Co | 8 | 5-64 | 2400 | 1000 | 1000 | 1 | 1500 |
| 5 | Ohio Edison Co | Stratton, Ohio | W H Sammis | Commonwealth Associates, Inc | 3[4] | 5-61 | 2400 | 1050 | 1000 | 1 | 1250 |
| 6 | Ohio Edison Co | Stratton, Ohio | W H Sammis | Commonwealth Associates, Inc | 4[4] | 1962 | 2400 | 1050 | 1000 | 1 | 1250 |
| 7 | Pacific Gas & Electric Co | Morro Bay, Calif | Morro Bay | | 3 | 8-62 | 2400 | 1050 | 1000 | 1 | 2160 |
| 8 | Pacific Gas & Electric Co | Morro Bay, Calif | Morro Bay | | 4 | 3-63 | 2400 | 1050 | 1000 | 1 | 2160 |
| 9 | Southern California Edison Co | Etiwanda, Calif | Etiwanda | Bechtel Corp | 3 | 3-63 | 2400 | 1050 | 1000 | 1[1] | 2305 |
| 10 | Southern California Edison Co | Etiwanda, Calif | Etiwanda | Bechtel Corp | 4 | 8-63 | 2400 | 1050 | 1000 | 1[1] | 2305 |
| 11 | Texas Electric Service Co | Handley, Texas | Handley | United Engrs & Constructors, Inc | 3 | 5-63 | 2400 | 1000 | 1000 | 1[1] | 2668 |
| 12 | Toledo Edison Co | Oregon, Ohio | Bay Shore | Gibbs & Hill, Inc | 3 | 6-63 | 2400 | 1050 | 1000 | 1 | 952 |
| 13 | West Penn Power Co | Courtney, Pa | Mitchell | Sanderson & Porter | 3 | 7-63 | 2400 | 1000 | 1000 | 1[2] | 2026 |
| 14 | Florida Power Corp | St Petersburg, Fla | Paul L Bartow | Black & Veatch | 3[3] | 7-63 | 2000 | 1000 | 1000 | 1 | 1423 |
| 15 | United Illuminating Co | Bridgeport, Conn | Bridgeport Harbor | Jackson & Moreland | 2 | 8-61 | 2000 | 1000 | 1000 | 1[2] | 1150 |
| 16 | Central Power & Light Co | Victoria, Texas | Victoria | Sargent & Lundy | 5 | 3-63 | 1875 | 1005 | 1005 | 1[1] | 1100 |
| 17 | Atlantic City Electric Co | Beesleys Point, N J | B L England | Bechtel Corp | 1[3] | 10-62 | 1800 | 1000 | 1000 | 1[2] | 883 |
| 18 | Boston Edison Co | Everett, Mass | Mystic | Jackson & Moreland | 6[3] | 4-61 | 1800 | 1000 | 1000 | 1 | 935 |
| 19 | Calgary Power Ltd | Wabamun, Alberta | Wabamun | Montreal Engineering Co Ltd | 3 | 10-62 | 1800 | 1005 | 1005 | 1[1] | 1018 |
| 20 | California Electric Power Co | Daggett, Calif | Cool Water | Fluor Corp, Ltd | 2 | 6-63 | 1800 | 1000 | 1000 | 1[1] | 475 |
| 21 | Gulf States Utilities Co | St Gabriel, La | Willow Glen | Stone & Webster Engrg Corp | 2 | 3-64 | 1800 | 1000 | 1000 | 1[1] | 1550 |
| 22 | Gulf States Utilities Co | St Gabriel, La | Willow Glen | Stone & Webster Engrg Corp | 3 | 3-65 | 1800 | 1000 | 1000 | 1[1] | 1550 |
| 23 | Iowa Public Service Co | Near Sioux City, Ia | George Neal | Ebasco Services, Inc | 1[3] | 5-64 | 1800 | 1000 | 1000 | 1[1] | 1050 |
| 24 | Kansas Power & Light Co | Tecumseh, Kansas | Tecumseh | Black & Veatch | 8 | 3-62 | 1800 | 1005 | 1005 | 1[1] | 942 |
| 25 | Kentucky Utilities Co | Dix Dam, Ky | E W Brown | Sargent & Lundy | 2 | 6-63 | 1800 | 1000 | 1000 | 1 | 1100 |
| 26 | Oklahoma Gas & Electric Co | Harrah, Okla | Horseshoe Lake | Sargent & Lundy | 7 | 5-63 | 1800 | 1000 | 1000 | 1[1] | 1286 |
| 27 | Southwestern Public Service Co | Amherst, Texas | Plant X | Self | 4 | 4-64 | 1800 | 1000 | 685 | 1[2] | 1400 |
| 28 | Tampa Electric Co | Tampa, Fla | Gannon | Stone & Webster Engrg Corp | 4 | 10-63 | 1800 | 1000 | 1000 | 1[1] | 1160 |
| 29 | El Paso Electric Co | El Paso, Texas | Newman | Stone & Webster Engrg Corp | 2 | 5-63 | 1450 | 1005 | 1005 | 1[1] | 467 |
| 30 | Consolidated Edison Co of N Y, Inc | New York, N Y | E 74th St Generating Station | | 11 | ..... | 1250 | 950 | ..... | ... | ..... |
| 31 | Consolidated Edison Co of N Y, Inc | New York, N Y | 59th St | | 14 | 12-61 | 615 | 750 | ..... | 3[2] | 300 |
| 32 | Montana-Dakota Utilities Co | Mandan, N D | R M Heskett | Ebasco Services, Inc | 2 | 10-63 | 1250 | 950 | ..... | 1[2] | 650 |
| 33 | Public Service Co of New Mexico | Alameda, N M | Reeves | Stearns-Roger | 1 | 7-60 | 1250 | 950 | ..... | 1[1] | 468 |
| 34 | Public Service Co of New Mexico | Alameda, N M | Reeves | Stearns-Roger | 3 | 1962 | 1250 | 950 | ..... | 1[2] | 700 |
| 35 | Upper Peninsula Generating Co | Marquette, Mich | Presque Isle | Stone & Webster Engrg Corp | 2 | 7-62 | 900 | 910 | ..... | 1 | 345 |
| 36 | Newfoundland Light & Power Co, Ltd | St John's, Newfoundland | South Side | Montreal Engineering Co Ltd | 2[5] | 12-59 | 850 | 900 | ..... | 1 | 190 |
| 37 | Saskatchewan Power Corp | Estevan, Saskatchewan | Boundary Dam | Ewbank & Partners Ltd | 1[5] | 10-58 | 850 | 900 | ..... | 1 | 600 |
| 38 | Saskatchewan Power Corp | Estevan, Saskatchewan | Boundary Dam | Ewbank & Partners Ltd | 2[5] | 10-59 | 850 | 900 | ..... | 1[2] | 600 |
| 39 | Saskatchewan Power Corp. | Saskatoon, Saskatchewan | Queen Elizabeth | R A Hanright & Co Ltd | 2[5] | 9-59 | 850 | 900 | ..... | 1[2] | 660 |
| 40 | St Joseph Light & Power Co | St Joseph, Mo | Lake Road | Black & Veatch | 3 | 1-62 | 275 | 675 | ..... | 2 | 110 |
| MUNICIPAL, FEDERAL AND COOPERATIVE INSTALLATIONS | | | | | | | | | | | |
| 41 | Tennessee Valley Authority | Knoxville, Tenn | Bull Run | Self | 1 | 7-65 | 3500 | 1000 | 1000 | 1[13] | 6400 |
| 42 | Tennessee Valley Authority | Colbert County, Ala | Colbert | Self | 5 | 7-62 | 2400 | 1050 | 1000 | 1[13] | 3900 |
| 43 | Tennessee Valley Authority | Muhlenberg, Ky | Paradise | Self | 1 | 9-62 | 2400 | 1050 | 1000 | 1[13] | 4900 |
| 44 | Tennessee Valley Authority | Muhlenberg, Ky | Paradise | Self | 2 | 9-62 | 2400 | 1050 | 1000 | 1[13] | 4900 |
| 45 | Tennessee Valley Authority | Bridgeport, Ala | Widows Creek | Self | 8 | 7-63 | 2400 | 1050 | 1000 | 1 | 3850 |
| 46 | Hydro-Electric Power Comm of Ontario | Toronto Twp, Ontario | Lakeview | Stone & Webster Engrg Corp | 1[9] | 1961 | 2350 | 1000 | 1000 | 1 | 2000 |
| 47 | Hydro-Electric Power Comm of Ontario | Toronto Twp, Ontario | Lakeview | Stone & Webster Engrg Corp | 2[9] | 1962 | 2350 | 1000 | 1000 | 1 | 2000 |
| 48 | Hydro-Electric Power Comm of Ontario | Toronto Twp, Ontario | Lakeview | Stone & Webster Engrg Corp | 3 | 1963 | 2350 | 1000 | 1000 | 1 | 2000 |
| 49 | Hydro-Electric Power Comm of Ontario | Toronto Twp, Ontario | Lakeview | Stone & Webster Engrg Corp | 4 | 1964 | 2350 | 1000 | 1000 | 1 | 2000 |
| 50 | Hydro-Electric Power Comm of Ontario | Fort William, Ontario | Thunder Bay | Ewbank & Partners Ltd | 1[9] | 1962 | 1450 | 1000 | ..... | 1 | 850 |
| 51 | City of Austin | Austin, Texas | Holly St | Brown & Root, Inc | 1[4] | 11-60 | 1450 | 1000 | 1000 | 1[1] | 800 |
| 52 | New Brunswick Electric Power Comm | E St John, New Brunswick | Courtenay Bay | H G Acres & Co Ltd | 1[9] | 8-61 | 1450 | 1000 | ..... | 1[1] | 460 |
| 53 | Puerto Rico Water Resources Authority | Guayanilla, P R | South Coast | Jackson & Moreland Inc | 3 | 1961 | 1450 | 1000 | 1000 | 1[1] | 650 |

At - Attemperator
By - Gas bypass
Cc - Cooling coils
Cool - Boiler water cooling
D - Damper
DB - Dry bottom
Du - Dual drive
FG - Flue gas recirculation
FR - Firing rate
Hy - Hydraulic coupling
M - Motor
Mp - Two motors per fan
N - None

Pd - Pressurized
Pre - Precondensing
Re - Regenerative
S - Speed control
ST - Slag tap
T - Turbine
TB - Tilting burners
Tu - Tubular
V - Vane control
WB - Wet bottom
WS - Water spray
1 - Outdoor unit
2 - Semi-outdoor unit

3 - Revised data, previously listed 10-60
4 - Revised data, previously listed 10-59
5 - Revised data, previously listed 12-57
6 - 1000 Btu per sq ft per hr
7 - Each
8 - Two per boiler
9 - Revised data, previously listed 10-58
10 - Cyclone
11 - 16 coal; 32 oil

12 - Oil; 40 gas
13 - Once through
14 - Natural gas; 12 fuel oil
15 - 8 burner stations; 3 oil, 6 gas per station
16 - 5 decks of 4 on coal; 4 decks of 4 on gas

MANUFACTURERS

AC - Allis-Chalmers Mfg Co
AEC - American Electric Crane
AEI - Associated Electrical Industries, Ltd

AH - American Hoist & Derrick Co
Ai - Alton & Co
AMC - American Meter Co, Inc
AP - Alco Products, Inc
AS - American Standard, Ind Div
ASH - Allen-Sherman-Hoff Co
AWS - American Water Softener Co
BA - Brush Aboe
BB - Brown Boveri Corp
BC - Bepco Canada Ltd
BF - Buffalo Forge Co
BJ - Byron-Jackson Pumps, Inc
BL - Betz Laboratories, Inc

# steam central-station installations

| Manufacturer | BOILERS: Surface, 1000 sq ft: Boiler & waterwalls | Superheater | Reheater | Economizer | Air heater | Superheat control | Reheat control | Air heater type | FURNACE: Pressure, in. water | Volume 1000 cu ft | Heat release, 1000 Btu per cu ft per hr | Number of burners | Bottom | F-D FANS: No. per boiler | Capacity each, 1000 cfm | Manufacturer | Air flow control | Drive | Drive hp | Drive manufacturer | I-D FANS: No. per boiler | Capacity each, 1000 cfm | Manufacturer | Gas-flow control | Drive | Drive hp | Drive manufacturer | Project Number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BW | 34.6 | 84.5 | 68.5<br>49.0 | 86.7 | 477 | FR | WS,FG | Re | 18.0 | 152.3 | 21.1 | 8[10] | ST,Pd | 2 | 400 | AS | S,Hy | M | 5000 | AS | N | ..... | ..... | ..... | ..... | ..... | ..... | 1 |
| CE | 29.5 | 117.8 | 23.3 | 68.6 | 196.9[7] | WS | TB | Re | -0.5 | 153.6 | 13.8 | 32 | DB | 2 | 289 | SW | V | M | 800 | WE | 2 | 434 | SW | V | M | 1500 | WE | 2 |
| BW | 32.2 | 65.0 | 34.3 | 27.3 | 234.8 | WS,FG | WS | Re | 7.5 | 76.6 | 26.2 | 4[10] | ST,Pd | 2 | 203.6 | WE | V | M | 2500 | WE | N | ..... | ..... | ..... | ..... | ..... | ..... | 3 |
| BW | ..... | ..... | ..... | ..... | ..... | WS,FG | WS | Re | ..... | ..... | ..... | 5[10] | ST,Pd | 2 | 303 | ..... | V | M | 3500 | EM | N | ..... | ..... | ..... | ..... | ..... | ..... | 4 |
| FW | 30.4 | 33.6 | 77.8 | 52.6 | 280.2 | Pre | By | Re | -0.10 | 94.6 | 18.0 | 15 | DB | 2 | 225 | SW | V | M | 550 | WE | 2 | 326 | SW | V | M | 895 | WE | 5 |
| FW | 30.4 | 33.6 | 77.8 | 52.6 | 280.2 | Pre | By | Re | -0.10 | 94.6 | 18.0 | 15 | DB | 2 | 225 | SW | V | M | 550 | WE | 2 | 326 | SW | V | M | 895 | WE | 6 |
| BW | 45.5 | 105.5 | 24.0 | 27.6 | 391 | WS,FG | FG | Re | 9 | 84.5 | 36.9 | 24 | Pd | 2 | 409 | WE | D,V | M | 2000 | WE | N | ..... | ..... | ..... | ..... | ..... | ..... | 7 |
| BW | 45.5 | 105.5 | 24.0 | 27.6 | 391 | WS,FG | FG | Re | 9 | 84.5 | 36.9 | 24 | Pd | 2 | 409 | GF | D,V | M | 2000 | AC | N | ..... | ..... | ..... | ..... | ..... | ..... | 8 |
| CE | 26.7 | 121.6 | 24.5 | 75.5 | 235.0[8] | WS,TB,FG | ..... | Re | 19 | 112.5 | 24.2 | ...[15] | Pd | 2 | 306 | AS | D,Hy | M | 2500 | WE | N | ..... | ..... | ..... | ..... | ..... | ..... | 9 |
| CE | 26.7 | 121.6 | 24.5 | 75.5 | 235.0[8] | WS,TB,FG | ..... | Re | 19 | 112.5 | 24.2 | ...[15] | Pd | 2 | 306 | AS | D,Hy | M | 2500 | WE | N | ..... | ..... | ..... | ..... | ..... | ..... | 10 |
| RS | 31.1 | 62.0 | 139.3 | 70.0 | 496.2 | WS | D,WS | Re | 11.4 | 136.2 | 28.8 | 24 | Pd | 2 | 425 | SW | Hy | M | 2500 | WE | N | ..... | ..... | ..... | ..... | ..... | ..... | 11 |
| BW | 12.5 | 80.7 | 17.6 | 39.8 | 243.4 | WS,FG | FG | Re | -.3 | 54 | 22.5 | 12 | DB | 2 | 188 | SW | V | M | 700 | GE | 2 | 263 | SW | V | M | 800 | GE | 12 |
| CE | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Re | ..... | ..... | ..... | ...[12] | DB,Pd | ... | ..... | ..... | ..... | ..... | ..... | ..... | .. | ..... | ..... | ..... | ..... | ..... | ..... | 13 |
| CE | 24.7 | 119.6 | 24.3 | 35.9 | 207.6 | WS,FG | TB | Re | 22 | 153.5 | 12.7 | 20[12] | DB,Pd | 2 | 220.5 | AS | Hy | M | 900 | GE | .. | ..... | ..... | ..... | ..... | ..... | ..... | 14 |
| BW | 21.2 | 86.1 | 26.4 | 23.1 | 295.0 | WS,FG | WS | Re | 12.0 | 49.9 | 29.3 | 5 | ST,Pd | 2 | 214 | BF | V | M | 2500 | WE | N | ..... | ..... | ..... | ..... | ..... | ..... | 15 |
| BW | 14.2 | 30.4 | 13.1 | 20.4 | 185.2 | WS,FG | WS,FG | Re | 7.5 | 51.4 | 30.9 | 16 | Pd | 2 | 210 | AS | D | M | 1000 | GE | .. | ..... | ..... | ..... | ..... | ..... | ..... | 16 |
| BW | 18.3 | ..... | ..... | 11.3 | 168 | WS,FG | WS,FG | Re | 22 | 46.6 | 32.2 | 3[10] | ST,Pd | 2 | 172 | AS | V | M | 2000 | GE | N | ..... | ..... | ..... | ..... | ..... | ..... | 17 |
| CE | 24.9 | 78.1 | 15.7 | 17.5 | 68.3 | WS,TB | WS,TB | Re | 0.15 | 59.1 | 21.6 | ...[11] | DB | 2 | 176 | WE | V | M | 600 | WE | 2 | 283 | WE | V | M | 1250 | WE | 18 |
| CE | 60.3 | 49.6 | 13.3 | 36.8 | 220.0 | WS,TB | TB | Re | ..... | 130.5 | 11 | ...[16] | WB | 2 | 182 | JH | S,V | M | 400 | CW | 2 | 289 | JH | S,V | M | 1000 | CW | 19 |
| CE | 11.4 | 32.5 | 5.3 | 11.6 | 77.2 | WS | WS,TB | Re | 20 | 24 | 28 | 16 | Pd | 1 | 180 | GF | V | M | 900 | GE | N | ..... | ..... | ..... | ..... | ..... | ..... | 20 |
| CE | 22.3 | 102 | 18.8 | 46.9 | 179.8 | WS,TB | WS,TB | Re | 12.0 | 131.0 | 98.5[6] | 24[14] | DB,Pd | 2 | 1130[19] | ..... | V | M | ..... | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | 21 |
| CE | 22.3 | 102 | 18.8 | 46.9 | 179.8 | WS,TB | WS,TB | Re | 12.0 | 131.0 | 98.5[6] | 24[14] | DB,Pd | 2 | 1130[19] | ..... | V | M | ..... | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | 22 |
| BW | 15.2 | 3.0 | ..... | 14.1 | 256.0 | WS,FG | WS | Tu | 14 | 56.5 | 24.0 | 3 | ST,Pd | 2 | ..... | IR | D,V | M | 2000 | AC | .. | ..... | ..... | ..... | ..... | ..... | ..... | 23 |
| CE | 16.0 | 52.0 | 13.7 | 30.6 | 140.8 | WS,TB | WS,TB | Re | 30 | 83 | ..... | ..... | Pd | 2 | 165 | WE | Hy | M | 1500 | GE | .. | ..... | ..... | ..... | ..... | ..... | ..... | 24 |
| CE | ..... | ..... | ..... | ..... | ..... | WS,TB | TB | Re | ..... | ..... | ..... | ..... | DB | 2 | ..... | SW | S,Hy | M | ..... | AC | N | ..... | ..... | ..... | ..... | ..... | ..... | 25 |
| BW | 23.6 | .5 | ..... | 141.3<br>111.1 | ..... | WS | WS,FG | N | 20.4 | 99.8 | 20 | 20 | Pd | 2 | 216 | AS | V | M | 1500 | GE | N | ..... | ..... | ..... | ..... | ..... | ..... | 26 |
| CE | 13.4 | 40.2 | 11.0 | 56.8 | 186.0 | WS,TB | WS,TB | Re | 10.9 | 57.7 | 29.4 | 40 | Pd | 2 | 233.5 | SW | D,V | M | 900 | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | 27 |
| BW | ..... | ..... | ..... | ..... | ..... | WS,FG | WS | Re | 12.2 | ..... | ..... | 4 | ST,Pd | 2 | 236 | JOY | V | M | 2250 | GE | N | ..... | ..... | ..... | ..... | ..... | ..... | 28 |
| BW | ..... | ..... | ..... | ..... | ..... | WS | WS | .... | ..... | ..... | ..... | 12 | Pd | 1 | 794 | SW | V | M | 1000 | WE | N | ..... | ..... | ..... | ..... | ..... | ..... | 29 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | .... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | .. | ..... | ..... | ..... | ..... | ..... | ..... | 30 |
| BW | 31.0 | 3.6 | N | N | 10.7 | ..... | ..... | Re | 10 | 14.9 | 27 | 5 | Pd | 1 | 94.5 | SW | ..... | M | 500 | WE | .. | ..... | ..... | ..... | ..... | ..... | ..... | 31 |
| RS | 30.5 | 27.7 | N | 17.4 | 81.3 | WS | ..... | Re | -0.05 | 43.6 | 19.9 | ..... | DB | 1 | 249 | GF | D,V | M | 700 | AC | 1 | 403 | GF | D,V | M | 1500 | AC | 32 |
| BW | 8.3 | ..... | ..... | 11.2 | 78 | WS | N | Re | 15 | 18 | 37 | 6 | Pd | 1 | 125 | SW | V | Mp | 800 | AC | N | ..... | ..... | ..... | ..... | ..... | ..... | 33 |
| BW | 10.8 | ..... | N | 16.6 | 124 | WS | ..... | Re | ..... | 27 | 32.5 | 9 | ..... | 1 | ..... | BF | ..... | Mp | 1000 | AC | N | ..... | ..... | ..... | ..... | ..... | ..... | 34 |
| CE | 27.5 | 7.2 | ..... | ..... | ..... | TB | ..... | Re | ..... | 18.0 | 20.6 | 4 | Pd | 1 | 97.5 | SW | D | M | 500 | AC | N | ..... | ..... | ..... | ..... | ..... | ..... | 35 |
| BW | 26 | 6 | N | N | 19.2 | WS | ..... | Tu | 5.2 | 8.5 | 29.3 | 5 | Pd | 1 | 43.4 | SW | D | M | 250 | MP | .. | ..... | ..... | ..... | ..... | ..... | ..... | 36 |
| BWG | 41.1 | 22.6 | N | 23.8 | 69.0 | WS | ..... | Re | -0.10 | 59.1 | 13.1 | 12 | WB | 2 | 109.8 | CS | V | M | 250 | BC | 2 | 178 | CS | S | M | 600 | BC | 37 |
| CE | 35.5 | 13.1 | ..... | ..... | 112.2 | WS,TB | ..... | .... | -0.15 | ..... | 16.9 | 4 | ..... | 2 | 111.5 | CS | V | M | 200 | LDC | 2 | 198 | CS | Hy | M | 450 | LD | 38 |
| FWL | 55.6 | 15.0 | N | N | 160.0 | Cc,Pre | ..... | Re | -0.20 | 52 | 16.5 | 8 | WB | 2 | 411[19] | CBF | D | M | 150 | GE | 2 | 477[19] | CS | S,Hy | M | 400 | GE | 39 |
| CE | 6.5 | 1.3 | N | N | N | ..... | ..... | .... | 10 | 1.67 | 117 | 2 | Pd | 1 | 50 | FA | V | M | 125 | AC | N | ..... | ..... | ..... | ..... | ..... | ..... | 40 |
| CE | ..... | ..... | ..... | ..... | ..... | WS | WS,TB | Re | ..... | ..... | ..... | 80 | DB,Pd | 4 | ..... | ..... | Hy | M | ..... | ..... | .. | ..... | ..... | ..... | ..... | ..... | ..... | 41 |
| BW | 32.2 | 260.8 | 83.2 | 108.6 | 158.4 | By,FR | WS | Re,Tu | 12.8 | 242 | 17.8 | 30 | DB,Pd | 4 | 350 | GF | Hy | M | 2000 | EL | N | ..... | ..... | ..... | ..... | ..... | ..... | 42 |
| BW | 41 | 252 | 82.8 | 141 | 1750 | FG,FR | WS,FG | Tu | 15.2 | 340 | 17.7 | 14[10] | ST,Pd | 4 | 400 | AS | S,Hy | M | 5500 | AC | .. | ..... | ..... | ..... | ..... | ..... | ..... | 43 |
| BW | 41 | 252 | 82.8 | 141 | 1750 | FG,FR | WS,FG | Tu | 15.2 | 340 | 17.7 | 14[10] | ST,Pd | 4 | 400 | AS | S,Hy | M | 5500 | AC | .. | ..... | ..... | ..... | ..... | ..... | ..... | 44 |
| CE | 48.7 | ..... | ..... | 229 | ..... | WS | WS,TB | Re | 30 | 429.2 | 11.7 | 40 | DB,Pd | 4 | 340 | SW | Hy | M | 2000 | WE | N | ..... | ..... | ..... | ..... | ..... | ..... | 45 |
| BWG | 69.7 | 137.5 | 48.1 | 49.0 | 174.4 | WS | WS,FG | Re | ..... | 141.7 | 19.9 | 24 | DB | 2 | 317 | JH | D,Hy | M | 750 | EE | 2 | 476 | JH | D,Hy | M | 1500 | EE | 46 |
| BWG | 69.7 | 137.5 | 48.1 | 49.0 | 174.4 | WS | WS,FG | Re | ..... | 141.7 | 19.9 | 24 | DB | 2 | 317 | JH | D,Hy | M | 750 | EE | 2 | 476 | JH | D,Hy | M | 1500 | EE | 47 |
| CE | 57.4 | 130.4 | 35.0 | 48.0 | 348.8 | WS,TB | ..... | Re | -0.15 | 167 | 16.0 | 40 | DB | 2 | 311.1 | JH | Hy | M | 550 | WE | 2 | 452.9 | JH | Hy | M | 1000 | WE | 48 |
| CE | 57.4 | 130.4 | 35.0 | 48.0 | 348.8 | WS,TB | ..... | Re | -0.15 | 167 | 16.0 | 40 | DB | 2 | 311.1 | JH | Hy | M | 550 | WE | 2 | 452.9 | JH | Hy | M | 1000 | WE | 49 |
| FWL | 39.0 | 18.9 | ..... | 33.1 | 74.3 | Pre | ..... | Re | ..... | 67.5 | 15.2 | 16 | DB | 2 | 108 | JH | S,D | M | 350 | ..... | 2 | 149.7 | JH | S,D | M | 600 | ..... | 50 |
| CE | ..... | 30.9 | 6.3 | 18.3 | 187.5 | WS,TB | TB | Re | 3 | 48 | 23.1 | 16 | Pd | 2 | 116.5 | SW | V | M | 600 | WE | .. | ..... | ..... | ..... | ..... | ..... | ..... | 51 |
| CES | 8.5 | 15.8 | ..... | 12.5 | 90.0 | WS,TB | ..... | Tu | 12.85 | 31.0 | 17.6 | 4 | Pd | 2 | 61.5 | CS | S,Hy | M | 200 | CGE | .. | ..... | ..... | ..... | ..... | ..... | ..... | 52 |
| CE | 16.8 | 37.7 | 6.6 | 16.6 | 93.0 | WS,TB | WS,TB | Re | ..... | 39.1 | 22.3 | 12 | DB | 2 | 128 | ..... | V | M | ..... | ..... | 2 | 172 | ..... | V | M | ..... | ..... | 53 |

BM - Bailey Meter Co
BP - Bingham Pump Co
BU - Buell Engineering Co, Inc
BW - Babcock & Wilcox Co
BWG - Babcock-Wilcox & Goldie McCulloch Ltd
CBF - Canadian Blower & Forge Co Ltd
CBL - Clyde Blowers Ltd
CCE - Continental Conveyor & Equipment Co
CE - Combustion Engineering, Inc
CES - Combustion Engrg Superheater Ltd
CF - Clarage Fan Co
CFB - C F Braun Co
CGE - Canadian General Electric Co Ltd
CH - Chicago Heater Co
CHW - C H Wheeler Mfg Co
COC - Cochrane Div, Crane Co
COP - Coppus Engrg Co
CP - C A Parsons & Co Ltd
CPL - Crompton Parkinson Ltd
CS - Canadian Sirocco Co Ltd
CV - Copes-Vulcan Div, Blaw-Knox Co
CW - Canadian Westinghouse Co Ltd
DBL - Dominion Bridge Ltd
DC - Duro Co
DE - Dearborn Chemical Co
DEC - Davis Engrg Corp
DL - DeLaval Steam Turbine Co
DP - Diamond Power Specialty Corp
DSC - Detroit Stoker Co
DT - Dage Television
EC - Erie City Iron Works
EE - English Electric Co Ltd
EL - Elliott Co
EPL - Evershed Powertronic Ltd
ES - Elgin Softener Corp
FA - Fly Ash Arrestor Corp
FE - Fairfield Engrg Co
FW - Foster Wheeler Corp
FWL - Foster Wheeler Ltd
GE - General Electric Co
GF - Green Fuel Economizer Co, Inc
GJW - G & J Weir, Ltd
GK - George Kent Ltd
GM - Graham Mfg Co
GR - Griscom-Russell Co
GW - Graver Water Conditioning Co
HA - Harland Engrg Co Ltd
HCC - Hagan Chemicals & Controls, Inc
HL - Hall Laboratories
HMc - Hills McCanna Co
HO - Hopkinsons Ltd
HP - Hoppers Mfg Co
HR - Hewitt Robins Inc
IN - Infilco Inc
IR - Ingersoll-Rand Co
IRL - Ingersoll-Rand Co Ltd
IW - Illinois Water Treatment Co
JH - James Howden & Co Ltd
JI - John Inglis Co Ltd
JOY - Joy Mfg Co
JT - John Thompson
K - E Keeler Co

# Steam central-station installations

**Table 1 continued**

| Project Number | BOILER FEED PUMPS: Capacity each, gpm | Discharge pressure, psig | Manufacturer | Flow control | Drive | Drive hp | Drive manufacturer | FUELS: Fuel type | Heating value, 1000 Btu per lb | Ash fusion temperature, F | Fuel delivery method | Coal unloading system | Unloading system manufacturer | Handling system to storage | Handling system manufacturer | FIRING: Coal firing equipment | Firing equipment manufacturer | No. pulverizers per boiler | Ash-handling system | Ash-handling system manufacturer | Soot blower type | Soot blowing medium | Soot blower manufacturer | Dust collector type | Dust collector manufacturer | Stack height, ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2300[19,22] 900[19,29] | 4756 3690 | WO | S,Hy | 1T[23] 1M | 20,800 4500 | WE AC | C,O | 13 | ..... | ..... | ..... | ..... | Co | ..... | Cy | ..... | ... | Hyd | ..... | Ro, Ret | Air | CV | El | ..... | 325 |
| 2 | 4450 | 3054 | IR | S | T | 9553 | GE | C | 13.3 | 2200 | RR | Dump | Ex | Co | FE | P | CE | 4 | Pn, Hyd | UC | Ro, Ret | ..... | CV | Me, El | BU | 400 |
| 3 | 1400 | 3012 | IR | R, Hy | 2M | 3000 | EL | C,G | 10.0 | 1900 | RR, Pi | Dump | LB | Co, Bu | LB | Cy | ..... | ... | FA | UC | Ro, Ret | Air | CV | El | WP | 402 |
| 4 | 1850 | 2750 | WO | R | 2M | ..... | EM | C,Ck | 10.4 | 1990 | RR | CS | ..... | Sc | ..... | Cy | ..... | ... | Hyd | ..... | Ret | Air | ..... | El | ..... | 274 |
| 5 | 1500 | 2750 | PP | R | 3M | 3500 | GE | C | 11.0 | 2100 | Ba, Tr | CT | McK | Co, Bu | LB | P | CE | 5 | Hyd, Pn | ASH, UC | Ro, Ret | Air | DP | El | BU | 500 |
| 6 | 1500 | 2750 | PP | R | 3M | 3500 | GE | C | 11.0 | 2100 | Ba, Tr | CT | McK | Co, Bu | LB | P | CE | 5 | Hyd, Pn | ASH, UC | Ro, Ret | Air | DP | El | BU | 500 |
| 7 | 2700 | 7000[17] | DL | Hy | 2T[23] | ..... | ..... | O,G | 18.5 | ..... | Pi, Sh | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | Ret | St | DP | ..... | ..... | 450 |
| 8 | 2700 | 7000[17] | DL | Hy | 2T[23] | ..... | ..... | O,G | 18.5 | ..... | Pi, Sh | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | Ret | St | DP | ..... | ..... | 450 |
| 9 | 5060[22] | 3100 | IR | Hy | T[23] | ..... | GE | O,G | 17.9 | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | Ro, Ret | Air | CV | N | ..... | 200 |
| 10 | 5060[22] | 3100 | IR | Hy | T[23] | ..... | GE | O,G | 17.9 | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | Ro, Ret | Air | CV | N | ..... | 200 |
| 11 | 5900[22] | 2950 | PP | Hy | T[23] | ..... | WE | G,O | 1080[18] | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | N | ..... | ..... | N | ..... | ..... |
| 12 | 1155 | 2760 | BJ | S, Hy | 2M | 2500 | GE | C | 12.2 | 2200 | RR, Sb | Dump, Sb | WL | Bu | LB | P | BW | 4 | Pn, Hyd | UC | Ro | Air | DP | El | WP | 250 |
| 13 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | C | ..... | ..... | ..... | ..... | ..... | ..... | ..... | P | CE | 5 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 14 | 3462 | 6325[17] | BJ | Hy | 1T[23], 1M[26] | ..... | ..... | O,G | 1000[18] | ..... | Ta, Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | CV | ..... | ..... | 300 |
| 15 | 1500 | 2750 | PP | N | 3M | 3000 | WE | C | 13.0 | 2280 | RR | CS | RO | Co, Bu | SA | Cy | BW | ... | Hyd | UC | Ro, Ret | St | DP | El | RC | 250 |
| 16 | 1560 | 2115 | PP | Hy | 2M | 2500 | GE | G | 1040[18] | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 137 |
| 17 | 1230 | 2204 | DL | R | 2M | 2000 | GE | C | 13.1 | 2300 | RR | CS | SA | Co | FE | Cy | PC | 2[35] | Pn, Hyd | UC | Ret | St | DP | ..... | BU | 250 |
| 18 | 1250 | 2180 | WO | R, Hy | 2M | 2000 | WE | C,O | 13.5 | 2200 | RR, Pi | CS | HR | Co | SA | P | CE | 4 | Pn | UC | Ro, Ret | St | CV | El | WP | 335 |
| 19 | 880 | 2254 | BP | R | 2M | 2000 | CW | C,G | 7.5 | 2100 | Tr, Pi | Hop | DBL | Co | DBL | P | CE | 5 | Hyd | UCC | Ro, Ret | St | DP | Me | JH | 300 |
| 20 | 1060 | 2200 | PP | R | 2M | 1750 | GE | G,O[31] | 1075[18] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 140 |
| 21 | 850[19] | ..... | IR | R | 2M | ..... | ..... | G | 1060 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 22 | 850[19] | ..... | IR | R | 2M | ..... | ..... | G | 1060 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 23 | 1235 | 2190 | IR | R | 2M | 2000 | AC | C,G | 12.5 | 2025 | RR | CS | ..... | Co, Bu | ..... | Cy | ..... | ... | Hyd | ..... | Ret | Air | DP | ..... | ..... | 250 |
| 24 | 1400 | 3000 | IR | R | 2M | 2500 | GE | C,O,G | ..... | ..... | RR | ..... | ..... | ..... | ..... | P | CE | 4 | Hyd | UC | Ret | Air | CV | ..... | ..... | ..... |
| 25 | ..... | ..... | IR | S, Hy | 2M | 2500 | AC | C | 12.0 | 2400 | RR | CS | HR | Bu, Sc | HR | P | CE | 4 | Pn, Hyd | UC | Ret | Air | DP | Me | RC | 350 |
| 26 | 1610 | 2457 | IR | Hy | 2M | 3000 | GE | G | 1148[18] | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 27 | 3000 | 2000 | WO | Hy | 2M | 3000 | ..... | G | 1000[18] | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 28 | 1500 | 2100 | IR | R | 2M | 2500 | GE | C | 11.5 | 2050 | Ba, RR | CS, SU | AH | Co, Bu | CCE | Cy | ..... | ... | Hyd | ..... | Ret | St | ..... | ..... | AS | 200 |
| 29 | 315[19] | 2350 | AC | R | 2M | 1250 | AC | G,O | 1080[18] | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 30 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 31 | 1315 | 880 | IR | R | 2T | 870 | MI | O | 18.4 | ..... | Ba | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | Ro, Ret | St | DP | ..... | ..... | 175 |
| 32 | 753 | 1635 | IR | R | 2M | 1000 | AC | L | 6.7 | 2270 | RR | CS | LB | Co, Bu, Sc | LB, FE | SS | RS | ... | Pn | UC | Ro, Ret | St | CV | Me | WP | 125 |
| 33 | 1000 | 1450 | PP | Hy | 2M | 1000 | WE | G | 1000[18] | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 115 |
| 34 | 1500 | 1500 | AC | R | 2M | 1750 | LAC | G,O | 1000[18] | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 118 |
| 35 | 900 | 940 | IR | R | 2M | 700 | AC | C | 11.5 | ..... | RR | ..... | ..... | Bu, Sc | ..... | P | CE | 1 | Hyd | UC | Ret | St | CV | ..... | ..... | 42 |
| 36 | 455 | 1100 | BP | R | 2M | 400 | MP | O | 18.5 | ..... | Sh | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | Ro, Ret | St | DP | ..... | ..... | 125 |
| 37 | 600 | 1140 | GJW | R | 3M | 700 | MV | L | 6.8 | 2156 | ..... | ..... | ..... | Co, Bu | LB | P | BW | 4 | Hyd | UC | Ret | St | DP | Me | PD | 150 |
| 38 | 600 | 1140 | GJW | R | 3M | 700 | MV | L | 6.8 | 2156 | ..... | ..... | ..... | Co, Bu | LB | P | CE | 4 | Hyd | UC | Ret | St | HO | Me | PD | 150 |
| 39 | 350[19] | 1140 | GJW | R | 2M, 1T | 685 | EE | CS | 8.5 | 2000 | RR | Dump | SH | Co, Bu | SAL | P | FW | 2 | Hyd | UC | Ro, Ret | St | CV | Me | PD | 150 |
| 40 | Ex | ..... | ..... | ..... | ..... | ..... | ..... | G,O | 980[18] | ..... | Pi, RR | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 41 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | C | 11.9 | 2170 | RR, Tr | ..... | ..... | Co | ..... | P | CE | 10 | Pn, Hyd | ..... | Ret | St | ..... | El | ..... | 600 |
| 42 | 4000 | 3570 | BJ | S | 2T, 1M[29] | 11,500 | CP | C | 11.2 | 2150 | Ba | Cl | ..... | Bu, Sc | ..... | P | BW | 10 | Pn, Hyd | ASH | Ro, Ret | Air | DP | El | KC | 500 |
| 43 | 5300 | 9350 | PP | S, Hy | 2T, 1M[29] | 15,700 | GE | C | 9.8 | 2150 | ..... | ..... | ..... | Bu, Sc | ..... | Cy | ..... | ... | Hyd | UC | Ro, Ret | Air | DP | ..... | ..... | 600 |
| 44 | 5300 | 9350 | PP | S, Hy | 2T, 1M[29] | 15,700 | GE | C | 9.8 | 2150 | ..... | ..... | ..... | Bu, Sc | ..... | Cy | ..... | ... | Hyd | UC | Ro, Ret | Air | DP | ..... | ..... | 600 |
| 45 | 4000 | 3125 | WO | S | 2T | 10,000 | BB | C | 12.7 | 2000 | Ba, RR Tr | Dump | LB | Co, Bu | LB | P | CE | 10 | Pn, Hyd | UC | Ret | St | CV | El | KC | 500 |
| 46 | 2400 | 2765 | HA | Hy | 3M | 5000 | WE | C | 13.2 | 2100 | Sh | SU | ..... | TS | ..... | P | BWG | 6 | Pn, Hyd | ASH | Ret | St | CV | Me, El | TCC | 490 |
| 47 | 2400 | 2765 | HA | Hy | 3M | 5000 | WE | C | 13.2 | 2100 | Sh | SU | ..... | TS | ..... | P | BWG | 6 | Pn, Hyd | ASH | Ret | St | CV | Me, El | TCC | 490 |
| 48 | 2200 | 2747 | HA | R, Hy | 3M | 4350 | CGE | C | 12.3 | 2400 | Sh | SU | ..... | Co | ..... | P | CE | 5 | Pn | UC, ASH | Ro, Ret | St | HO | El | RC | 490 |
| 49 | 2200 | 2747 | HA | R, Hy, | 3M | 4350 | CGE | C | 12.3 | 2400 | Sh | SU | ..... | Co | ..... | P | CE | 5 | Pn | UC, ASH | Ro, Ret | St | HO | El | RC | 490 |
| 50 | 770[19] | 1785 | MP | R, Hy | 2M | 2900 | CGE | C | 13.2 | 2100 | Ba | Cr | ..... | Co | SA | P | FWL | 4 | Pn, Hyd | JT | Ro, Ret | St | CBL | Me, El | RC | 350 |
| 51 | 990 | 1860 | WO | R | 2M | 1250 | WE | G | 1060[18] | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 155 |
| 52 | 1118 | 1605 | MP | S, Hy | 2M | 1350 | MP | O,C | 17.9 | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | Ret | St | DP | ..... | ..... | 350 |
| 53 | 1340 | 1700 | AC | R | 2M | 1500 | AC | O,TP | 16.5 | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | Ret | St | CV | ..... | ..... | 205 |

KC - Koppers Co
LAC - Louis Allis Co
LB - Link-Belt Co
LBL - Link-Belt Ltd
LDC - Lancashire Dynamo & Crypto Ltd
LI - Lapp Insulator Co, Inc
LN - Leeds & Northrup Co
McK - McKiernan Terry Co
MI - Murray Iron Works
ML - Montreal Locomotive Works Ltd
MP - Mather & Platt Ltd
MR - Milton Roy Co
MS - Maryland Shipbuilding & Drydock Co
MV - Metropolitan Vickers
PC - Pennsylvania Crusher Co
PD - Pratt-Daniel Corp
PM - Permutit Co, Div Pfaulder Permutit
PP - Pacific Pumps, Inc
RC - Research-Cottrell, Inc
RF - Republic Flow Meters Co
RHE - Ross Heat Exchanger Div
RO - Robbins & Meyers, Inc
RS - Riley Stoker Corp
SA - Stephens Adamson Mfg Co
SAL - Stephens-Adamson Mfg Co of Canada Ltd
SC - Sturtevant Co of Canada, Ltd
SH - Strachen & Henshaw, Ltd
SP - Springfield Boiler Co
SW - Sturtevant Div, Westinghouse Electric Corp
SWC - Struthers Wells Corp
SWE - Southwestern Engrg Co
TCC - T C Chown Ltd
UC - United Conveyor Corp
UCC - United Conveyor Corp of Canada Ltd
UI - Union Iron Works
US - U S Electrical Motors Inc
WE - Westinghouse Electric Corp
WI - Wickes Boiler Co
WL - Wellman Conveyors
WO - Worthington Corp
WP - Western Precipitation Corp
YU - Yuba Heat Transfer Div

SYMBOLS USED ABOVE

Ad - Admiralty
Adi - Admiralty, inhibited
AlB - Aluminum brass
AsAd - Arsenical Admiralty
AsAlB - Arsenical aluminum brass
AsCu - Arsenical Copper
Ba - Barge
Br - Brass
Bu - Bulldozer
C - Coal, bituminous
Cc - Cooling coils
CC - Cross compound
Ck - Coke
Cl - Clam
CNi - Copper nickel iron
Co - Conveyor
Con - Condenser
Cr - Crane

| HEATER | | | | | CONDENSER | | | | | | | | TURBINES | | | | | | | | | CONTROLS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number | Hi-press heater exit temperature, F | Max deaerating pressure, psia | Manufacturer | Deaeration | Surface, 1000 sq ft | No. of water passes | Tube material | Air removal | Manufacturer | Feedwater treatment (raw water) | Feedwater pH | System manufacturer | Number | Capability each, 1000 kw | Turbine type | Manufacturer | Exhaust pressure, psia | No. of bleedpoints | No. main turbine exhausts | Main generator voltage, kv | Generator rating, 1000 kva (mva) | Generator cooling | Combustion control mfr | Feedwater control mfr | Closed-circuit TV mfr | Total boiler capacity including new units, 1000 lb per hr | Total generator capability including new units, 1000 kw | Project Number |
| 16 | 537 | Con | YU | Hot | 210 | 1 | AlB,SS | Ro | WO | De | 8.8 | ..... | 1[1] | 400 | TC | WE | 0.75 | 8 | 4 | 19 | 466.4 | $H_2$,HC | ..... | ..... | ..... | 2450 | 400 | 1 |
| 8 | 531 | 165 | WE | H,Hot | 95 | 1 | Ad | RP | IR | De | 8.8 | IW | 1[27] | 250 | CC | GE | 0.75 | 4 | 1 | 15.5[7] | 150[7] | $H_2$ | LN | HCC | ..... | 2850 | 415 | 2 |
| 6 | 457 | 122 | FW | H | 90 | 1 | PAd | J,Ro | IR | De,So | 9.0 | COC | 1 | 193 | TC | GE | 0.75 | 6 | 2 | 22 | 224 | $H_2$,HC | LN | COC | DP | 1200 | 193 | 3 |
| 7 | 485 | 85.9 | ..... | H | 130 | 2 | AdI | J | FW | De | 8.5 | ..... | 1 | 225 | TC | GE | 0.75 | 7 | 2 | 22.0 | 256 | Li | BM | BM | N | 5160 | 503 | 4 |
| 8 | 523 | ..... | GR | Hot | 90 | 2 | AdI | RP | WO | De | 8.8 | IN | 1 | 185[21] | TC | WE | 0.75 | 8 | 3 | 20 | 224 | $H_2$,HC | BM | BM | N | 5000 | 740[21] | 5 |
| 8 | 523 | ..... | GR | Hot | 90 | 2 | AdI | RP | WO | De | 8.8 | IN | 1 | 185[21] | TC | WE | 0.75 | 8 | 3 | 20 | 224 | $H_2$,HC | BM | BM | N | 5000 | 740[21] | 6 |
| 7 | 476 | ..... | CFB,FW, WE | Hot | 130 | 1 | AlB | J | WE | Ev | 9.0 | ..... | 1[30] | 300 | CC | WE | 0.75 | 7 | 4 | 18 | 192 | $H_2$ | BM | BM | DP | ..... | 990 | 7 |
| 7 | 476 | ..... | CFB,FW, WE | Hot | 130 | 1 | AlB | J | WE | Ev | 9.0 | ..... | 1[30] | 300 | CC | WE | 0.75 | 7 | 4 | 18 | 192 | $H_2$ | BM | BM | DP | ..... | 990 | 8 |
| 8 | 528 | 147 | CFB | H,Hot | 160 | 2 | ..... | J,RP | IR | So,Ev | ..... | ..... | 1[1,27] | 310 | CC | GE | 1.0 | 8 | 1[24] | 18 | 370 | $H_2$ | HCC | HCC | N | 6400 | 880 | 9 |
| 8 | 528 | 147 | CFB | H,Hot | ..... | ... | ..... | ..... | ..... | So,Ev | ..... | ..... | 1[1,27] | 310 | CC | GE | 1.0 | 8 | 1[24] | 18 | 370 | $H_2$ | HCC | HCC | N | 6400 | 880 | 10 |
| 7 | 471 | ..... | WE | Hot | 202 | 1 | AdI | Ro | WE | Ev | ..... | ..... | 1[1] | 350 | TC | WE | 1.5 | 7 | 4 | 19 | 460 | $H_2$,HC | HCC | HCC | N | 3923 | 475 | 11 |
| 8 | 516 | 50 | FW | H | 85 | 1 | PAd | J,Ro | WO | De | 8.8 | ..... | 1 | 145 | TC | WE | 0.5 | 8 | 2 | 18 | 165 | $H_2$ | BM | BM | DP | 2852 | 405 | 12 |
| .... | ..... | ..... | ..... | H | 115 | 2 | ..... | J | MS | ..... | ..... | ..... | 1 | 250 | TC | WE | 0.75 | 7 | 4 | ..... | 288 | $H_2$,HC | ..... | ..... | ..... | ..... | 424 | 13 |
| 7 | ..... | 190 | GR | H | ..... | 1 | CNI | Ro | WE | De | ..... | ..... | 1 | 204[21] | TC | GE | 1.0 | 7 | 3 | ..... | ..... | Li | ..... | ..... | ..... | 3223 | 446 | 14 |
| 6 | 460 | 125 | AP,FW, EL,RHE | H | 75 | 1 | AlB | J | FW | De | 8.2 | HL | 1 | 150 | TC | GE | 0.75 | 9 | 2 | 20 | 192 | $H_2$,Li | BM | BM | DP | 1770 | 246 | 15 |
| 6 | 457 | 150 | GR,WO | H,Hot | 80 | 2 | AsAd | Ro | WE | De | ..... | MR | 1[20] | 160 | TC | GE | 1.75 | 9 | 1 | 20 | 212 | $H_2$ | ..... | ..... | ..... | 2030 | 259 | 16 |
| 6 | 453 | 97.5 | YU | H | 62.5 | 1 | AlB | J | IR | De | ..... | COC | 1[1] | 136 | TC | GE | 0.75 | 6 | 2 | 15 | 160 | $H_2$ | BM | BM | N | 883 | 136 | 17 |
| 6 | 460 | 115 | GR,COC | H | 75 | 1 | AsAlB | J | WO | De | 8.8 | MR,LI | 1 | 137.5 | TC | GE | 0.75 | 6 | 3 | 18 | 184 | $H_2$ | BM | BM | DP | 4185 | 537.5 | 18 |
| 6 | 460 | 74 | AEI | H | 73 | 2 | Ad | J | AEI | So,Ev | ..... | GW | 1[20] | 150 | TC | AEI | 14.3 | 7 | 3 | 16.5 | 167 | $H_2$ | BM | BM | DP | 2265 | 294 | 19 |
| 5 | 440 | 70 | SWE,YU | H | 42.5 | 2 | AsCu | Ro | IR | De | ..... | ..... | 1[1] | 60 | TC | AC | 1.0 | 5 | 2 | 13.8 | 76.8 | $H_2$ | BM | BM | ..... | 950 | 135 | 20 |
| 6 | ..... | ..... | ..... | Hot | 125 | 2 | ..... | Ro | FW | De | 6.8 | PM | 1 | 200 | TC | GE | 1.75 | 6 | 3 | 22 | 281.6 | GC,Li | ..... | ..... | ..... | 4200 | 602 | 21 |
| 6 | ..... | ..... | ..... | Hot | 125 | 2 | ..... | Ro | FW | De | 6.8 | PM | 1 | 200 | TC | GE | 1.75 | 6 | 3 | 22 | 281.6 | GC,Li | ..... | ..... | ..... | 4200 | 602 | 22 |
| 6 | 465 | ..... | WE | H | 70 | 2 | PAd | Ro | IR | De,So | ..... | ..... | 1 | 150 | TC | GE | 0.75 | 6 | 2 | 18 | 173 | $H_2$ | ..... | ..... | ..... | 1050 | 150 | 23 |
| 6 | 500 | ..... | GR | Hot | 95 | 2 | Ad | J | CHW | De | ..... | ..... | 1[1] | 175 | TC | WE | 1.25 | 6 | 2 | 16 | 176 | HC,GC | BM | BM | GE | ..... | 370 | 24 |
| 6 | 475 | 75 | AP,PM | H,Hot | ..... | 2 | Ad | J | AC | De | 9 | ..... | 1 | 156 | TC | WE | 1.5 | 6 | 1 | 18 | 202 | $H_2$ | ..... | ..... | ..... | ..... | 2b1 | 25 |
| 6 | 435 | 37.4 | YU,EL | H | 85 | 1 | Ad | Ro | FW | De | ..... | ..... | 1[32] | 188.5 | TC | GE | 1.75 | 6 | 2 | 22 | 235 | Li | BM | BM | N | 12,386 | 235 | 26 |
| 6 | 453 | 136 | ..... | ..... | 102 | 2 | AsAd | J | AC | Ev, So, De | ..... | ..... | 1[33] | 25 | ...[33] | GE | 18.5[34] | N | 1 | 13.8 | 32 | $H_2$ | BM | BM | ..... | 2700 | 487.5 | 27 |
| 6 | 417 | ..... | CFB,WE | Hot | 95 | 1 | ..... | J | WE | De | ..... | ..... | 1 | 175[21] | TC | WE | 0.75 | 6 | 2 | 18 | 192 | $H_2$,HC,GC | ..... | ..... | N | ..... | 615 | 28 |
| 5 | ..... | ..... | ..... | H | ..... | 2 | Ad | J | AC | So,Ev | ..... | ..... | 1 | 75 | TC | GE | 0.75 | 5 | 2 | 13.8 | 108 | $H_2$ | BM | BM | N | 1200 | 180 | 29 |
| ... | ..... | ..... | ..... | .... | ..... | ... | ..... | ..... | ..... | De | 9 | COC | 1[20] | 35 | SC | GE | 200 | 0 | 1 | 11.0 | 30.0 | Air | ..... | ..... | ..... | ..... | ..... | 30 |
| 1 | 339 | 18 | ..... | .... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | 1 | 22.5 | ..... | GE | 240 | 0 | 1 | ..... | ..... | ..... | BM | BM | ..... | ..... | ..... | 31 |
| 5 | 460 | 75 | YU | H | 35 | 2 | Ad | Ro | AC | So,Ev | 8.8 | WO,COC | 1[20] | 80 | TC | GE | 1.75 | 5 | 1 | 13.8 | 88.2 | $H_2$ | BM | BM | N | 960 | 107 | 32 |
| 5 | 420 | 64 | ..... | H | 35 | 2 | Ad | J | WE | So,Ev | 8.5 | ..... | 1[20] | 50 | TC | WE | 0.75 | 5 | 1 | 13.8 | 58.6 | $H_2$ | BM | BM | N | 935 | 100 | 33 |
| 5 | 430 | 64 | YU | ..... | 55 | 2 | Ad | J | WE | Ev | 8.5 | ..... | 1[20] | 75 | TC | AC | 0.75 | 5 | 2 | 13.8 | 88.2 | $H_2$ | BM | BM | N | 1550 | 175 | 34 |
| 5 | ..... | ..... | WE | Hot | 18 | 2 | ..... | J | AC | Ev | ..... | ..... | 1[20] | 37.5 | SC | GE | 0.75 | 5 | 1 | 13.8 | 44.1 | $H_2$ | BM | BM | ..... | 565 | 60 | 35 |
| 4 | 345 | 58 | AEI | H | 14 | 2 | AlB | J | AEI | De | 9 | PM | 1 | 20 | SC | AEI | 0.75 | 4 | 1 | 13.8 | 25.0 | Air | EPL | EPL | ..... | 300 | 30 | 36 |
| 5 | 388 | ..... | CP | H | 48 | 2 | Br | J | CP | So,Ev | 8.8 | AI | 1 | 66 | TC | CP | 0.75 | 5 | 2 | 14.4 | 82.5 | $H_2$ | GK | GK | ..... | 1200 | 132 | 37 |
| 5 | 388 | ..... | CP | H | 48 | 2 | Br | J | CP | So,Ev | 8.8 | AI | 1 | 66 | TC | CP | 0.75 | 5 | 2 | 14.4 | 82.5 | $H_2$ | GK | GK | ..... | 1200 | 132 | 38 |
| 5 | 388 | 20 | ..... | H | 48 | 2 | Br | J | EE | De | 8.8 | DC | 1[20] | 66 | TC | EE | 0.75 | 5 | 2 | 14.4 | 82.5 | $H_2$ | BM | BM | ..... | 1320 | 141 | 39 |
| 2 | ..... | ..... | Ex | ..... | 17 | 2 | ..... | J | WE | ..... | ..... | ..... | 1 | 18 | ..... | WE | 1.0 | 4 | 1 | 13.8 | 15.6 | Air | BM | BM | N | 920 | 67 | 40 |
| 8 | 550 | 158 | ..... | H,Hot | 320 | 1 | Ad | Ro | ..... | ..... | ..... | ..... | 1[27] | 900 | CC | GE | 0.75 | 8 | 4 | 24 | 1050 | $H_2$,HC,Li | ..... | ..... | ..... | 6400 | 900 | 41 |
| 8 | 520 | 135 | COC,WE | H,Hot | 260 | 1 | AdI | Ro | WE | De,So | 10.7 | HMC | 1[30] | 500 | CC | CP | 0.75 | 8 | 8 | 24 | 278[7] | $H_2$,Li | RF | RF | ..... | 9020 | 1220 | 42 |
| 8 | 533 | 175 | GW,CFB | H,Hot | 300 | 1 | AdI | Ro | FW | Ev | 10.5 | ..... | 1[27] | 650 | CC | GE | 0.75 | 8 | 4 | 24 | 361[7] | $H_2$,Li | RF | RF | ..... | 9800 | 1300 | 43 |
| 8 | 533 | 175 | GW,CFB | H,Hot | 300 | 1 | AdI | Ro | FW | Ev | 10.5 | ..... | 1[27] | 650 | CC | GE | 0.75 | 8 | 4 | 24 | 361[7] | $H_2$,Li | RF | RF | ..... | 9800 | 1300 | 44 |
| 13 | 527 | 97 | AP | H,Hot | 220 | 1 | Ad | Ro | WE | So,Ev | ..... | ..... | 1[30] | 500 | CC | BB | 0.75 | 8 | 8 | 24 | 556 | $H_2$,HC,Li | ..... | ..... | ..... | ..... | ..... | 45 |
| 7 | 462 | 115 | YU,ML | H,Hot | 125 | 1 | Ad | J,Ro | FW | De | 8.8 | ..... | 1[27] | 300 | CC | CP | 0.5 | 7 | 4 | 16 | 353 | $H_2$ | BM | BM | DP | 2000 | 300 | 46 |
| 7 | 462 | 115 | COC | H,Hot | 125 | 1 | Ad | J,Ro | FW | De | 8.8 | ..... | 1[27] | 300 | CC | CP | 0.5 | 7 | 3 | 16 | 353 | $H_2$ | BM | BM | DP | 4000 | 600 | 47 |
| 7 | 462 | 100 | GW,ML | H,Hot | 90 | 1 | ..... | J,Ro | CHW | De,So | 8.8 | IN | 1 | 300 | TC | AEI | 0.5 | 6 | 4 | 18 | 353 | $H_2$ | HCC | HCC | ..... | 6000 | 900 | 48 |
| 7 | 462 | 100 | GW,ML | H,Hot | 90 | 1 | ..... | J,Ro | CHW | De,So | 8.8 | IN | 1 | 300 | TC | AEI | 0.5 | 6 | 4 | 18 | 353 | $H_2$ | HCC | HCC | ..... | 8000 | 1200 | 49 |
| 5 | ..... | ..... | FW | ..... | 53.6 | 1 | Ad | J,Ro | FW | De | ..... | ..... | 1 | 100 | TC | EE,J1 | 0.5 | 5 | 3 | 13.8 | 111 | $H_2$ | BM | BM | ..... | 850 | 100 | 50 |
| 5 | 460 | 82.4 | COC,SWC | H | 65 | 2 | Ad | J | WE | De | 6.8 | IW | 1[20] | 100 | TC | WE | 0.75 | 4 | 1 | 13.8 | 122 | $H_2$ | RF | RF | DT | 800 | 100 | 51 |
| 5 | 449 | 72 | GW,ML | H | 34 | 2 | Yo | J | FWL | De | 9.2 | DE | 1 | 50 | TC | EE | 0.5 | ... | 2 | 13.8 | 55.9 | $H_2$ | BM | BM | DP | 460 | 50 | 52 |
| 6 | 455 | 70 | ..... | H | 65 | 2 | AlB | J | ..... | De | ..... | ..... | 1[1] | 90 | TC | GE | 1.25 | 6 | 2 | 13.8 | 110 | $H_2$ | BM | BM | ..... | 1650 | 190 | 53 |

CS - Car shaker
C-s - Coal, sub-bituminous
CT - Coal tower
Cy - Cyclone
De - Demineralizer
Dump - Bumper
El - Electrostatic
Elev - Elevator
Ev - Evaporator
Ex - Existing equipment
FA - Fly ash reinjection
G - Gas
GC - Gas cooled
H - Heater
$H_2$ - Hydrogen

HC - Hollow conductor
Hop - Dump hopper
Hot - Condenser hotwell
Hy - Hydraulic coupling
Hyd - Hydraulic
J - Steam jet
L - Lignite
Li - Liquid
M - Motor
Me - Mechanical
N - None
O - Oil
P - Pulverizer
PAd - Phosphorized Admiralty
Pi - Pipeline

Pn - Pneumatic
R - Regulator
Ret - Retractable
Ro - Rotary pump or blower
RP - Reciprocating pump
RR - Railroad
S - Speed control
Sb - Self-unloading boat
Sc - Scraper
SC - Single cylinder
Sh - Ship
So - Softener
SS - Spreader stoker
SSt - Stainless steel
St - Steam

Sta - Stationary
SU - Self-unloading ship
T - Turbine
Ta - Tanker
TC - Tandem compound
TG - Traveling grate
TH - Track hopper
TP - Tar pitch
Tr - Truck
TS - Tractor scraper
Yo - Yorkalbro metal
17 - Feet
18 - Btu per cu ft
19 - 1000 lb per hr
20 - Preferred standard

21 - Nameplate
22 - Main pump
23 - Main turbine shaft
24 - Axial flow
25 - 10 mw in dual-fuel engines
26 - Half size
27 - Hp 3600, lp 1800 rpm
28 - Softening temperature
29 - Start-up
30 - 3600/3600 rpm
31 - Future coal
32 - Steam turbine
33 - Gas turbine
34 - Inches of water
35 - Crushers

# Table 2

# 1961 design survey of typical

Compiled by: BGA Skrotzki, Associate Editor and Althea Thornton

| | Company | Location | Plant Name | Consulting Engineers | Unit No., new unit | First operation, new unit | Throttle pressure, psig | Steam temperature, F | | Steam generating unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Throttle | Reheat | Number | Capacity each, 1000 lb per hr |
| 54 | City of Rochelle | Rochelle, Ill | Municipal | Pfeifer & Shultz | ... | 61-62 | 875 | 905 | ..... | 2 | 90 |
| 55 | Willmar Municipal Utilities Comm | Willmar, Minn | Municipal | Pfeifer & Shultz | ... | 7-60 | 875 | 900 | ..... | 1 | 160 |
| 56 | City of Brownsville | Brownsville, Texas | Si Ray Extension | Brown & Root | 6 | 6-61 | 850 | 900 | ..... | $1^1$ | 215 |
| 57 | Eastern Iowa Light & Power Coop | Montpelier, Iowa | Montpelier | Stanley Engineering Co | 1 | 2-60 | 850 | 900 | ..... | 1 | 215 |
| 58 | Medina Electric Cooperative | Pearsall, Texas | Pearsall | Laramore, Douglass & Popham Inc | 1 | 1961 | 850 | 910 | ..... | $1^1$ | 235 |
| 59 | Medina Electric Cooperative | Pearsall, Texas | Pearsall | Laramore, Douglass & Popham Inc | 2 | 1961 | 850 | 910 | ..... | $1^1$ | 235 |
| 60 | Medina Electric Cooperative | Pearsall, Texas | Pearsall | Laramore, Douglass & Popham Inc | 3 | 1961 | 850 | 910 | ..... | $1^1$ | 235 |
| 61 | Orrville Municipal Utilities | Orrville, Ohio | N Vine St | H Ralph Hadlow | 9 | 9-61 | 850 | 900 | ..... | ... | ..... |
| 62 | Rochester Electric Dept | Rochester, Minn | Silver Lake | Pfeifer & Shultz | 3 | 8-62 | 850 | 900 | ..... | 1 | 220 |
| 63 | Springfield Water, Light & Power Dept | Springfield, Ill | Lakeside | Burns & McDonnell | 6 | ..... | 850 | 900 | ..... | 1 | 320 |
| 64 | Tallahassee Electric Dept | St Marks, Fla | St Marks | Reynolds, Smith & Hills | 6 | 10-60 | 850 | 905 | ..... | $1^1$ | 220 |
| 65 | Manitoba Hydro-Electric Board | Selkirk, Manitoba | Selkirk | Ewbank & Partners Ltd | 1 | 8-60 | 835 | 900 | ..... | 2 | 600 |
| 66 | Manitoba Hydro-Electric Board | Selkirk, Manitoba | Selkirk | Ewbank & Partners Ltd | 2 | 10-60 | 835 | 900 | ..... | 1 | 600 |
| 67 | Nova Scotia Power Comm | Trenton, Nova Scotia | Trenton | ..... | 4[5] | 11-60 | 630 | 825 | ..... | 1 | 250 |
| 68 | City of Alliance | Alliance, Neb | Municipal | Black & Veatch | 1 | 11-61 | 600 | 825 | ..... | 1 | 100 |
| 69 | Garden City Municipal Utilities | Garden City, Kan | Municipal | Black & Veatch | 1 | 5-62 | 600 | 825 | ..... | 1 | 125 |
| 70 | City of Lake Worth | Lake Worth, Fla | Municipal | Russell & Axon | 1 | 2-61 | 600 | 825 | ..... | 1 | 100 |
| 71 | City of Natchitoches | Natchitoches, La | Municipal | Barnard & Burk, Inc | 8 | 6-62 | 600 | 825 | ..... | $1^1$ | 75 |
| 72 | City of Anthony | Anthony, Kan | Municipal | A C Kirkwood & Assoc | 4 | 12-61 | 400 | 750 | ..... | $1^2$ | 50 |
| 73 | City of Clay Center | Clay Center, Kan | Municipal | A C Kirkwood & Assoc | 7 | 5-62 | 400 | 750 | ..... | 1 | 73.5 |
| 74 | Springfield Public Utilities Comm | Springfield, Minn | ..... | Foster, Jacobs & Johnson | 4 | ..... | 400 | ..... | ..... | ... | ..... |
| 75 | Lansing Board of Water & Light | Lansing, Mich | ..... | ..... | ... | 1961 | 175 | Sat | ..... | 1 | 50 |

At - Attemperator
By - Gas bypass
Cc - Cooling coils
Cool - Boiler water cooling
D - Damper
DB - Dry bottom
Du - Dual drive
FG - Flue gas recirculation
FR - Firing rate
Hy - Hydraulic coupling
M - Motor
Mp - Two motors per fan
N - None

Pd - Pressurized
Pre - Precondensing
Re - Regenerative
S - Speed control
ST - Slag tap
T - Turbine
TB - Tilting burners
Tu - Tubular
V - Vane control
WB - Wet bottom
WS - Water spray
1 - Outdoor unit
2 - Semi-outdoor unit

3 - Revised data, previously listed 10-60
4 - Revised data, previously listed 10-59
5 - Revised data, previously listed 12-57
6 - 1000 Btu per sq ft per hr
7 - Each
8 - Two per boiler
9 - Revised data, previously listed 10-58
10 - Cyclone
11 - 16 coal; 32 oil

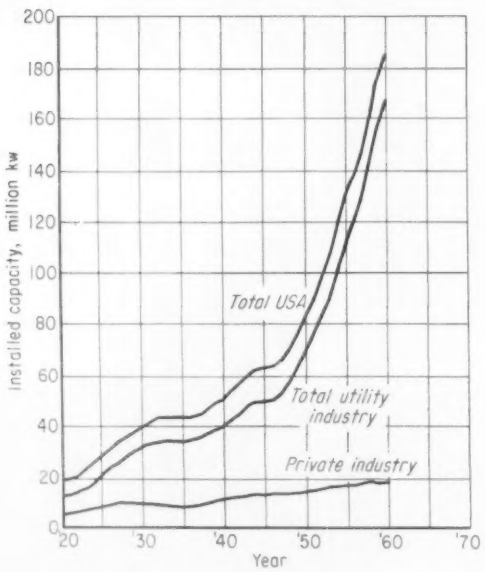
12 - Oil; 40 gas
13 - Once through
14 - Natural gas; 12 fuel oil
15 - 8 burner stations; 3 oil, 6 gas per station
16 - 5 decks of 4 on coal; 4 decks of 4 on gas

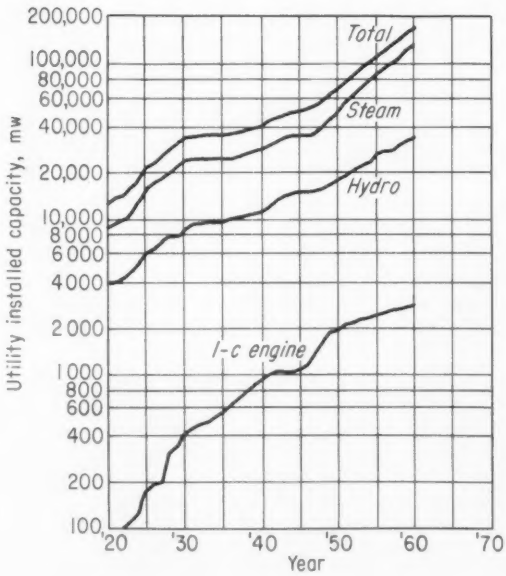
MANUFACTURERS

AC - Allis-Chalmers Mfg Co
AEC - American Electric Crane
AEI - Associated Electrical Industries, Ltd

AH - American Hoist & Derrick Co
Al - Alton & Co
AMC - American Meter Co, Inc
AP - Alco Products, Inc
AS - American Standard, Ind Div
ASH - Allen-Sherman-Hoff Co
AWS - American Water Softener Co
BA - Brush Aboe
BB - Brown Boveri Corp
BC - Bepco Canada Ltd
BF - Buffalo Forge Co
BJ - Byron-Jackson Pumps, Inc
BL - Betz Laboratories, Inc

## Growing energy demands force utility industry




**INSTALLED CAPACITY** of all types of central stations, and of plants owned by private industry, promises continued expansion. Economic activity of U.S. will have strong influence on energy systems' rate of growth in future. Private capacity is 10.6% of utility capacity

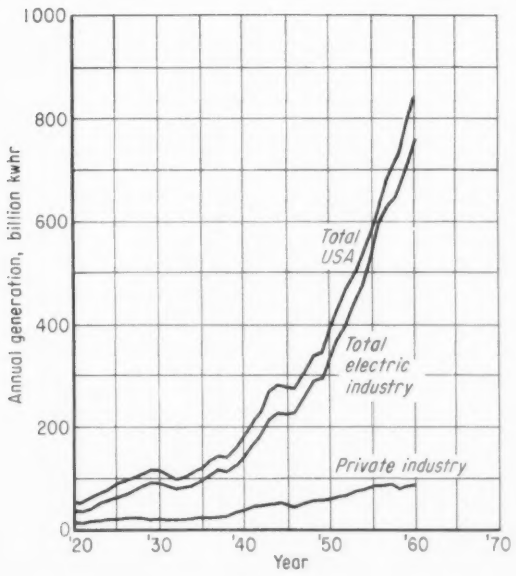
**UTILITY INSTALLED CAPACITY** in 1960 had 79.00% in steam, 19.34% in hydro and 1.66% in internal-combustion plants. From 1950 to 1960 steam capacity grew an average of 10.3% yearly, hydro 6.24% and internal combustion 3.86%. Steam's share will keep growing

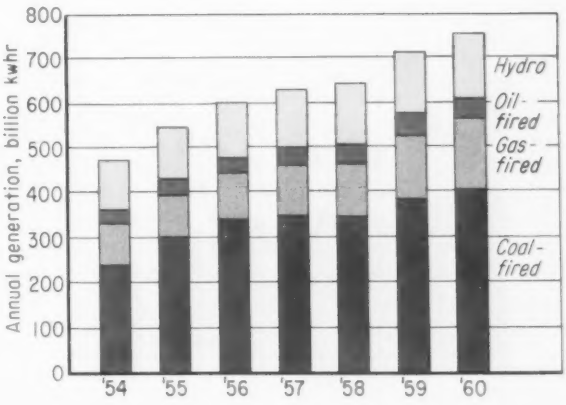
# steam central-station installations

| Manufacturer | BOILERS: Surface, 1000 sq ft: Boiler & waterwalls | Superheater | Reheater | Economizer | Air heater | Superheat control | Reheat control | Air heater type | FURNACE: Pressure, in. of water | Volume, 1000 cu ft | Heat release, 1000 Btu per cu ft per hr | No. of burners | Bottom | F-D FANS: No. per boiler | Capacity each, 1000 cfm | Manufacturer | Air flow control | Drive | Drive hp | Drive manufacturer | I-D FANS: No. per boiler | Capacity each, 1000 cfm | Manufacturer | Gas-flow control | Drive | Drive hp | Drive manufacturer | Project Number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BW | 8.6 | 2.7 | ..... | 2.1 | 4.6 | At | ..... | Re | ..... | 5.0 | 26.2 | 4 | DB | 1 | 35.2 | CF | D | M | 60 | EL | 1 | 54.5 | CF | D | Mp | 125 | EL | 54 |
| BW | 17.3 | 4.6 | N | 4.4 | 13.9 | Cool | ..... | Tu | ..... | 8.5 | ..... | ..... | ..... | 1 | 48 | CF | V | M | 125 | WE | 1 | 88.5 | CF | D | Mp | 250/100 | WE | 55 |
| CE | 13.5 | ..... | ..... | ..... | 26.7 | ..... | ..... | Re | ..... | 7.0 | 42 | 4 | ..... | 1 | 75.5 | SW | V | M | 300 | WE | 1 | 113 | SW | D | M | 300 | WE | 56 |
| RS | 26.9 | 10.8 | N | N | 25.6 | Cc | ..... | Re | -0.1 | 15.9 | 18.0 | 4 | DB | 1 | 80 | GF | D | M | 200 | GE | 1 | 130 | CF | D,Hy | M | 400 | GE | 57 |
| SP | 16.2 | 1.3 | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | 4 | Pd | 1 | ..... | GF | D | Mp | ..... | US | N | ..... | ..... | ..... | ..... | ..... | ..... | 58 |
| SP | 16.2 | 1.3 | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | 4 | Pd | 1 | ..... | GF | D | Mp | ..... | US | N | ..... | ..... | ..... | ..... | ..... | ..... | 59 |
| SP | 16.2 | 1.3 | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | 4 | Pd | 1 | ..... | GF | D | Mp | ..... | US | N | ..... | ..... | ..... | ..... | ..... | ..... | 60 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | 61 |
| BW | 17.7 | 10.0 | N | N | 35.1 | Cool | ..... | Re | ..... | 14.3 | 19.8 | 4 | DB | 1 | 80.4 | CF | V | M | 150 | WE | 1 | 134 | CF | Hy | M | 300 | WE | 62 |
| BW | 17.0 | 13.7 | N | N | ..... | ..... | ..... | Re | 15 | ..... | 70 | 2[10] | ST,Pd | 1 | ..... | SW | V | M | 1000 | ..... | N | ..... | ..... | ..... | ..... | ..... | ..... | 63 |
| RS | 24.7 | 10.2 | N | N | 17.1 | Cc | N | Re | ..... | 16 | 18.9 | 6 | DB | 1 | 86.6 | AS | V | M | 200 | WE | 1 | 121.3 | AS | D | Mp | 60/250 | WE | 64 |
| BWG | 29.6 | 4.7 | N | N | 156.4 | Cool | ..... | Re | -0.10 | 61.6 | 13.1 | 12 | WB | 2 | 349[19] | SC | V,Hy | M | 250 | BA | 2 | 433[19] | JH | D,Hy | M | 375 | BA | 65 |
| BWG | 29.6 | 4.7 | N | N | 156.4 | Cool | ..... | Re | -0.10 | 61.6 | 13.1 | 12 | WB | 2 | 349[19] | SC | V,Hy | M | 250 | BA | 2 | 433[19] | JH | D,Hy | M | 375 | BA | 66 |
| BW | 29.6 | ..... | ..... | ..... | 31.1 | WS | ..... | Tu | ..... | 13.6 | ..... | 4 | DB | 1 | 54.9 | JH | V,Hy | M | 125 | CPL | 1 | 90.3 | JH | V,Hy | M | 220 | CPL | 67 |
| EC | 15.5 | 3.4 | N | 8.5 | N | Cc | ..... | ... | -0.8 | 6.4 | 20.6 | 3 | DB | 1 | 36.7 | AS | V | M | 75 | GE | 1 | 71.0 | AS | S | M | 100/250 | GE | 68 |
| BW | 8.3 | 1.7 | ..... | ..... | 10.4 | ..... | ..... | Re | ..... | 3.1 | 51.5 | 6 | Pd | 1 | 46.8 | SW | S,D | Mp | 100/200 | GE | N | ..... | ..... | ..... | ..... | ..... | ..... | 69 |
| BW | 5.9 | ..... | ..... | ..... | 11.3 | WS | N | Re | 30 | 2.1 | ..... | 4 | Pd | 1 | 145[19] | AS | D | Mp | 200/50 | AC | N | ..... | ..... | ..... | ..... | ..... | ..... | 70 |
| SB | 7.4 | 2.8 | ..... | ..... | 2.0 | WS | N | Re | 12 | 3.1 | 34.5 | 2 | Pd | 1 | 28 | GF | V | M | 75 | WE | N | ..... | ..... | ..... | ..... | ..... | ..... | 71 |
| WI | 4.4 | 0.5 | ..... | ..... | 4.7 | ..... | ..... | Re | 5.0 | 1.1 | 59.5 | 1 | DB | 1 | 73.7[19] | SW | D | M | 60 | WE | N | ..... | ..... | ..... | ..... | ..... | ..... | 72 |
| UI | 4.8 | 1.4 | ..... | ..... | ..... | By | ..... | Re | 6.4 | 1.3 | 71.7 | 2 | Pd | 1 | 24.9 | FA | V | M | 100 | AC | N | ..... | ..... | ..... | ..... | ..... | ..... | 73 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | 74 |
| WI | 5.3 | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | 60 | ..... | ..... | 1 | ..... | ..... | D | T | ..... | COP | ... | ..... | ..... | ..... | ..... | ..... | ..... | 75 |

BM - Bailey Meter Co
BP - Bingham Pump Co
BU - Buell Engineering Co, Inc
BW - Babcock & Wilcox Co
BWG - Babcock-Wilcox & Goldie McCulloch Ltd
CBF - Canadian Blower & Forge Co Ltd
CBL - Clyde Blowers Ltd
CCE - Continental Conveyor & Equipment Co
CE - Combustion Engineering, Inc
CES - Combustion Engrg Superheater Ltd
CF - Clarage Fan Co
CFB - C F Braun Co
CGE - Canadian General Electric Co Ltd
CH - Chicago Heater Co
CHW - C H Wheeler Mfg Co
COC - Cochrane Div, Crane Co
COP - Coppus Engrg Co
CP - C A Parsons & Co Ltd
CPL - Crompton Parkinson Ltd
CS - Canadian Sirocco Co Ltd
CV - Copes-Vulcan Div, Blaw-Knox Co
CW - Canadian Westinghouse Co Ltd
DBL - Dominion Bridge Ltd
DC - Duro Co
DE - Dearborn Chemical Co
DEC - Davis Engrg Corp
DL - DeLaval Steam Turbine Co
DP - Diamond Power Specialty Corp
DSC - Detroit Stoker Co
DT - Dage Television
EC - Erie City Iron Works
EE - English Electric Co Ltd
EL - Elliott Co
EPL - Evershed Powertronic Ltd
ES - Elgin Softener Corp
FA - Fly Ash Arrestor Corp
FE - Fairfield Engrg Co
FW - Foster Wheeler Corp
FWL - Foster Wheeler Ltd
GE - General Electric Co
GF - Green Fuel Economizer Co, Inc
GJW - G & J Weir, Ltd
GK - George Kent Ltd
GM - Graham Mfg Co
GR - Griscom-Russell Co
GW - Graver Water Conditioning Co
HA - Harland Engrg Co Ltd
HCC - Hagan Chemicals & Controls, Inc
HL - Hall Laboratories
HMc - Hills McCanna Co
HO - Hopkinsons Ltd
HP - Hoppers Mfg Co
HR - Hewitt Robins Inc
IN - Infilco Inc
IR - Ingersoll-Rand Co
IRL - Ingersoll-Rand Co Ltd
IW - Illinois Water Treatment Co
JH - James Howden & Co Ltd
JI - John Inglis Co Ltd
JOY - Joy Mfg Co
JT - John Thompson
K - E Keeler Co

# onto new, higher operating plateaus




**ANNUAL GENERATION** of utility and private plants reflects growth of U.S. industry. Between 1950 and 1960 utility generation grew an average of 8.63% yearly and private generation 3.94%. In 1960 private generation came to about 11.6% of total utility generation

**ANNUAL ENERGY-SOURCE PRODUCTION** shows coal to be predominant, generating over half of total each year. In 1960 coal generated 53.45% of total kwhr, gas 21.08%, hydro 19.32% and oil 6.15%. Gas firing will probably increase its share of total in future

# Steam central-station installations

**Table 2 continued**

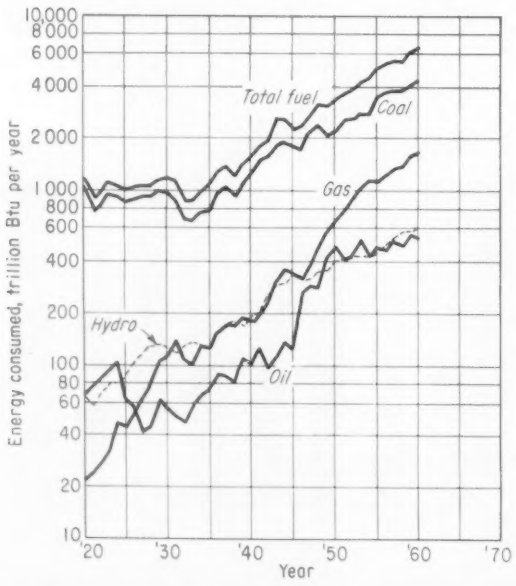
| Project Number | BOILER FEED PUMPS | | | | | | | FUELS | | | | | | | | FIRING | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Capacity each, gpm | Discharge pressure, psig | Manufacturer | Flow control | Drive | Drive hp | Drive manufacturer | Fuel type | Heating value 1000 Btu per lb | Ash fusion temperature, F | Fuel delivery method | Coal unloading system | Unloading system manufacturer | Handling system to storage | Handling system manufacturer | Coal firing equipment | Firing equipment manufacturer | No. pulverizers per boiler | Ash-handling system | Ash-handling system manufacturer | Soot blower type | Soot blowing medium | Soot blower manufacturer | Dust collector type | Dust collector manufacturer | Stack height, ft | |
| 54 | 240 | 2760[17] | PP | R | M | 250 | EL | C,G | 11.5 | 2100 | RR | CS | FE | Co,Bu | FE | SS,TG | DSC | ... | Pn | UC | Ret | Air | DP | Me | WP | 150 | |
| 55 | Ex | ..... | ..... | ..... | ..... | ..... | ..... | C | 12 | 2045 | RR | TH | ..... | Elev | ..... | SS,TG | DSC | ... | Pn | UC | Ro, Ret | Air | DP | Me | WP | 70 | |
| 56 | 350 | 1100 | PP | R | 2M | 300 | WE | G | 1050[18] | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 91 | |
| 57 | 567 | 1200 | AC | R | 2M | 500 | AC | C | 10.5 | 1950 | Ba,RR | Cr | AEC | Bu | SA | P | RS | 2 | Hyd | ASH | ..... | St | DP | Me | PD | 50 | |
| 58 | 250 | 1600 | PP | R | 3M | 250 | EL | G,O | 1000[18] | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | |
| 59 | 250 | 1600 | PP | R | 3M | 250 | EL | G,O | 1000[18] | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | |
| 60 | 250 | 1600 | PP | R | 3M | 250 | EL | G,O | 1000[18] | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | |
| 61 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | |
| 62 | 500 | 1200 | PP | R | 2M | 500 | WE | C,G | 12.2 | 2000 | RR,Pi | CS | HR | Bu | LB | P | BW | 2 | Pn | UC | Ro,Ret | St | DP | Me | WP | 97 | |
| 63 | 450 | 1250 | BJ | ..... | 2M | 400 | GE | C | 10.5 | 2100 | Tr | ..... | ..... | Bu | ..... | Cy | ..... | ... | Hyd | UC | Ro,Ret | St | DP | ..... | ..... | 55 | |
| 64 | 560 | 1325 | BJ | R | 2M | 600 | WE | O,G | 18.3 | ..... | Ba,Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | Ret | St | DP | ..... | ..... | 125 | |
| 65 | 720[19] | 1123 | IML | Hy | 2M | 1375 | EE | L | 7.3 | 2100 | RR | CS | HR | Co,Sc | LBL | P | BWG | 4 | Pn,Hyd | UC | Ro,Ret | St | DP | Me | TCC | 250 | |
| 66 | 720[19] | 1123 | IML | Hy | 2M | 1375 | EE | L | 7.3 | 2100 | RR | CS | HR | Co,Sc | LBL | P | BWG | 4 | Pn,Hyd | UC | Ro,Ret | St | DP | Me | TCC | 250 | |
| 67 | 420 | 800 | MP | R | M | 360 | MP | C | 9.5 | 1900[28] | RR | CS | Ex | Co | ..... | P | BW | 2 | Hyd | UC | Ro,Ret | St,Air | DP | Me | ..... | 250 | |
| 68 | 240 | 930 | IR | R | 2M | 200 | GE | C,G | 9.3 | ..... | RR,Pi | TH | FE | Co | FE | TG | DSC | ... | Pn | ASH | Ro | ..... | CV | Me | AS | 50 | |
| 69 | 125[19] | 850 | IR | R | 2M | 200 | GE | G | 900[18] | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | |
| 70 | 220 | 725 | BJ | R | M | 150 | AC | O,G | 1060[18] | ..... | Tr,Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | Ro | St | DP | Me | AS | 40 | |
| 71 | 175 | 1620[17] | PP | R | 2M | 100 | WE | G | 1000[18] | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 40 | |
| 72 | 105 | 1274[17] | PP | R | M | 60 | LAC | G,O | 1060[18] | ..... | RR,Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | St | ..... | ..... | ..... | ..... | |
| 73 | 146 | 550 | PP | R | 1M,1T | 75 | LAC | G | 945[18] | ..... | Pi | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | |
| 74 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | |
| 75 | ..... | ..... | WO | R | M | ..... | ..... | O | 19.0 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | St | CV | ..... | ..... | ..... | |

KC - Koppers Co
LAC - Louis Allis Co
LB - Link-Belt Co
LBL - Link-Belt Ltd
LDC - Lancashire Dynamo & Crypto Ltd
LI - Lapp Insulator Co, Inc
LN - Leeds & Northrup Co
McK - McKiernan Terry Co
MI - Murray Iron Works
ML - Montreal Locomotive Works Ltd
MP - Mather & Platt Ltd
MR - Milton Roy Co
MS - Maryland Shipbuilding & Drydock Co
MV - Metropolitan Vickers
PC - Pennsylvania Crusher Co
PD - Prat-Daniel Corp
PM - Permutit Co, Div Pfaudler Permutit
PP - Pacific Pumps, Inc
RC - Research-Cottrell, Inc
RF - Republic Flow Meters Co
RHE - Ross Heat Exchanger Div
RO - Robbins & Meyers, Inc
RS - Riley Stoker Corp
SA - Stephens Adamson Mfg Co
SAL - Stephens-Adamson Mfg Co of Canada Ltd
SC - Sturtevant Co of Canada, Ltd
SH - Strachan & Henshaw, Ltd
SP - Springfield Boiler Co
SW - Sturtevant Div, Westinghouse Electric Corp
SWC - Struthers Wells Corp
SWE - Southwestern Engrg Co
TCC - T C Chown Ltd
UC - United Conveyor Corp
UCC - United Conveyor Corp of Canada Ltd
UI - Union Iron Works
US - U S Electrical Motors Inc
WE - Westinghouse Electric Corp
WI - Wickes Boiler Co
WL - Wellman Conveyors
WO - Worthington Corp
WP - Western Precipitation Corp
YU - Yuba Heat Transfer Div

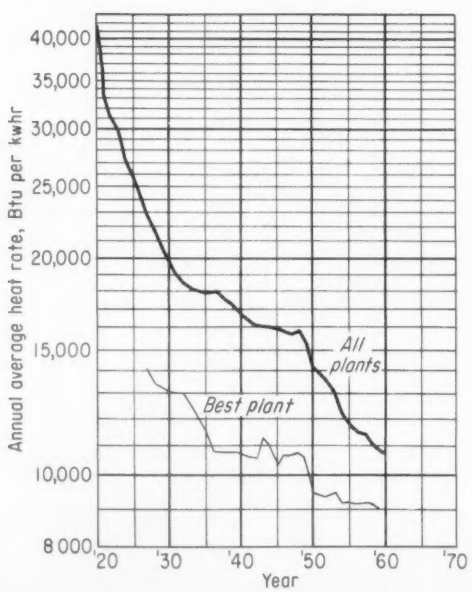
SYMBOLS USED ABOVE

Ad - Admiralty
AdI - Admiralty, inhibited
AlB - Aluminum brass
AsAd - Arsenical Admiralty
AsAlB - Arsenical aluminum brass
Ba - Barge
Br - Brass
Bu - Bulldozer
C - Coal, bituminous
Cc - Cooling coils
CC - Cross compound
Ck - Coke
Cl - Clam
CNI - Copper nickel iron
Co - Conveyor
Con - Condenser
Cr - Crane

# Rising thermal economy and better system load




**ANNUAL ENERGY CONSUMPTION of utility plants in 1960 was 7.08 x $10^{15}$ Btu, including true energy in falling water. From 1950 to 1960 average yearly consumption growths were 6.96% for coal, 10.54% for gas, 1.14% for oil, 4.32% for hydro, 6.96% all fuels**

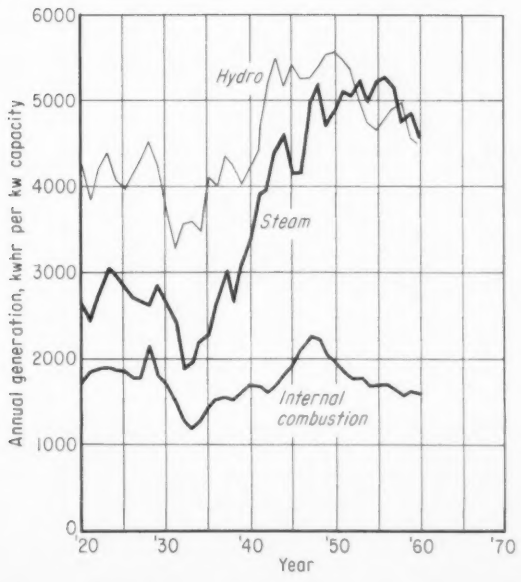



**ANNUAL AVERAGE HEAT RATE of utility plants shows steady decline as newer, more efficient plants are added. A 9000-Btu heat-rate average seems likely in next decade. Gap of 7000 Btu between best plant and average in 1930 has shrunk to 1700 Btu in 1960**

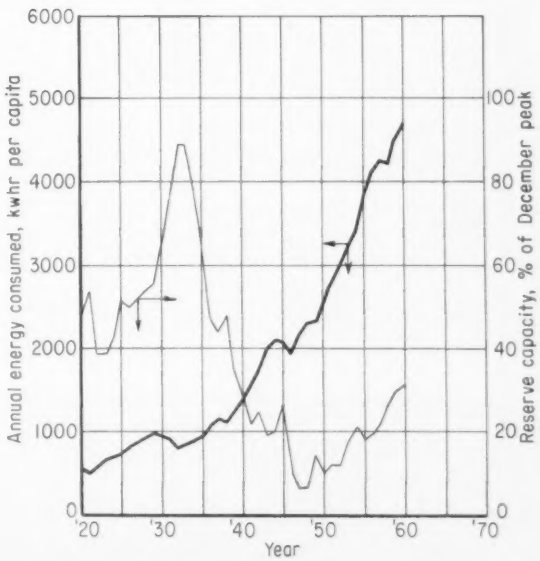
| HEATER | | | | | CONDENSER | | | | | | | | TURBINES | | | | | | | | | CONTROLS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number | High-pressure heater exit temperature, F | Max deaerating pressure, psia | Manufacturer | Deaeration | Surface, 1000 sq ft | No. of water passes | Tube material | Air removal | Manufacturer | Feedwater treatment (raw water) | Feedwater pH | System manufacturer | Number | Capability each, 1000 kw | Turbine type | Manufacturer | Exhaust pressure, psia | No. of bleedpoints | No. main turbine exhausts | Main generator voltage, kv | Generator rating, 1000 kva (mva) | Generator cooling | Combustion control manufacturer | Feedwater control manufacturer | Closed-circuit TV manufacturer | Total boiler capacity including new units, 1000 lb per hr | Total generator capability including new units, 1000 kw | Project number |
| 2 | 370 | 55 | ..... | H,Hot | 12 | 2 | PAd | J | El | De,So | ..... | COC | 1 | 12.5 | ..... | El | 1.0 | 4 | 1 | 13.9 | 13.5 | Air | BM | BM | ..... | 180 | ..... | 54 |
| ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ..... | ..... | 325 | 15.3 | 55 |
| 3 | 354 | 75 | GR | ..... | 25 | 2 | AsAd | J | CHW | De | 6.9 | ..... | 1 | 25 | SC | WE | 0.75 | 4 | 1 | 13.8 | 29.4 | $H_2$ | BM | BM | ..... | ..... | 52 | 56 |
| 4 | 360 | 60 | RHE | ..... | 18 | 2 | ..... | J | MS | De | 8.6 | IW | 1[20] | 22 | SC | WE | 0.75 | 4 | ... | 13.8 | 29.4 | $H_2$ | RF | RF | N | 215 | 22 | 57 |
| 4 | ..... | ..... | ..... | H | 18 | 2 | Ad | J | EL | De,So | ..... | COC | 1[20] | 22 | ..... | BB | 0.75 | 4 | 1 | 13.8 | ..... | $H_2$ | RF | RF | N | 705 | 66 | 58 |
| 4 | ..... | ..... | ..... | H | 18 | 2 | Ad | J | EL | De,So | ..... | COC | 1[20] | 22 | ..... | BB | 0.75 | 4 | 1 | 13.8 | ..... | $H_2$ | RF | RF | ..... | 705 | 66 | 59 |
| 4 | ..... | ..... | ..... | H | 18 | 2 | Ad | J | EL | De,So | ..... | COC | 1[20] | 22 | ..... | BB | 0.75 | 4 | 1 | 13.8 | 13.8 | $H_2$ | RF | RF | ..... | 705 | 66 | 60 |
| 1 | ..... | ..... | ..... | H,Hot | 19 | 2 | Ad | J | WE | So | ..... | COC | 1[20] | 22 | SC | AC | 1.0 | 3 | 1 | 13.8 | 22 | $H_2$ | HCC | HCC | ..... | 330 | 38.5 | 61 |
| 4 | 349 | ..... | HP,GR | H | 18 | 2 | PAd | J | WO | So,Ev | 8.3 | GW,GR | 1[20] | 22 | SC | WE | 0.75 | 4 | 1 | 13.8 | 29.4 | $H_2$ | RF | RF | ..... | 430 | 42 | 62 |
| 5 | ..... | 50 | GW | H | ..... | 2 | Ad | J | YU | De,Ev | 8.5 | IW | 1[20] | 3 | SC | AC | 0.75 | 5 | 1 | 13.8 | 35.3 | $H_2$ | HCC | CV | ..... | 1445 | 113 | 63 |
| 4 | 297 | 75 | YU | H | 19 | 2 | AlB | J | CHW | Ev | 7.6 | ..... | 1[20] | 22 | SC | WE | 0.75 | 4 | ... | 12.5 | 29.4 | $H_2$ | RF | BL | N | 780 | 74 | 64 |
| 5 | 410 | 57.6 | CP | H | 50 | 2 | Br | J | CP | De | 9 | COC | 1[20] | 66 | TC | CP | 0.5 | 5 | 2 | 13.8 | 77.5 | $H_2$ | BM | BM | DP | 1200 | 132 | 65 |
| 5 | 410 | 57.6 | CP | H | 50 | 2 | Br | J | CP | De | 9 | COC | 1[20] | 66 | TC | CP | 0.5 | 5 | 2 | 13.8 | 77.5 | $H_2$ | BM | BM | DP | 1200 | 132 | 66 |
| 3 | 340 | ..... | CP | Hot | 21 | 2 | Yo | J | CP | Ev | 8 | ..... | 1[20] | 20 | SC | CP | 0.75 | 3 | 1 | 13.2 | 25.0 | Air | BM | BM | ..... | 720 | 60 | 67 |
| 2 | ..... | 27 | DEC,AWS | H | 7 | 2 | Ad | J | CHW | So,Ev | ..... | ES,DEC | 1 | 7.5 | SC | GE | 1.75 | 3 | 1 | 12.5 | 9.4 | Air | CV | CV | ..... | ..... | ..... | 68 |
| 3 | 381 | ..... | YU | Hot | 10 | 2 | AdI | J | CHW | Ev | ..... | BM | 1 | 9.4 | SC | GE | 1.75 | 3 | 1 | 12.5 | 13.5 | Air | BM | BM | ..... | ..... | ..... | 69 |
| 3 | 370 | 75.4 | CH | ..... | 8.5 | 2 | Ad | J | WO | De | ..... | ..... | 1[20] | 7.5 | SC | WO | 1.25 | 3 | 1 | 4.2 | 9.4 | Air | BM | BM | ..... | 100 | 7.5 | 70 |
| 2 | 275 | 45 | WE,COC | H | 6.0 | 2 | ..... | J | WE | Ev | ..... | AMC | 1 | 7.5 | SC | WE | 1.0 | 3 | 1 | 13.8 | 7.5 | Air | RF | RF | ..... | 75 | 17.5[25] | 71 |
| 2 | ..... | 20 | COC,GM | ..... | 4.5 | 2 | Ad | J | CHW | So | ..... | COC | 1 | 3.8 | SC | WE | 1.0 | 3 | 1 | 12.5 | 3.8 | Air | BM | BM | ..... | 96 | 6.9 | 72 |
| 3 | 340 | 5 | WO,AS | H | 7 | 2 | Ad | J | WO | Ev | 8.5 | ..... | 1 | 5.9 | SC | GE | 1.0 | 3 | 1 | 13.2 | 6.6 | Air | RF | RF | N | ..... | 11.9 | 73 |
| ..... | ..... | ..... | ..... | ..... | 6 | 2 | Ad | J | EL | ..... | ..... | ..... | 1 | 4 | SC | WO | 14 | 2 | 1 | 2.4/4.2 | 5.0 | Air | ..... | ..... | ..... | ..... | 7.8 | 74 |
| ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ..... | ..... | So | ..... | ..... | N | ..... | ..... | ..... | ..... | ... | ... | ..... | ..... | ..... | ..... | ..... | ..... | 116 | ..... | 75 |

CS - Car shaker
C-s - Coal, sub-bituminous
CT - Cool tower
Cy - Cyclone
De - Demineralizer
Dump - Dumper
El - Electrostatic
Elev - Elevator
Ev - Evaporator
Ex - Existing equipment
FA - Fly ash reinjection
G - Gas
GC - Gas cooled
H - Heater
$H_2$ - Hydrogen
HC - Hollow conductor
Hop - Dump hopper
Hot - Condenser hotwell
Hy - Hydraulic coupling
Hyd - Hydraulic
J - Steam jet
L - Lignite
Li - Liquid
M - Motor
Me - Mechanical
N - None
O - Oil
P - Pulverizer
PAd - Phosphorized Admiralty
Pl - Pipeline
Pn - Pneumatic
R - Regulator
Ret - Retractable
Ro - Rotary pump or blower
RP - Reciprocating pump
RR - Railroad
S - Speed control
Sb - Self-unloading boat
Sc - Scraper
SC - Single cylinder
Sh - Ship
So - Softener
SS - Spreader stoker
SSt - Stainless steel
St - Steam
Sta - Stationary
SU - Self-unloading ship
T - Turbine
Ta - Tanker
TC - Tandem compound
TG - Traveling grate
TH - Track hopper
TP - Tar pitch
Tr - Truck
TS - Tractor scraper
Yo - Yorkalbro metal
17 - Feet
18 - Btu per cu ft
19 - 1000 lb per hr
20 - Preferred standard
21 - Nameplate
22 - Main pump
23 - Main turbine shaft
24 - Axial flow
25 - 10 mw in dual-fuel engines
26 - Half size
27 - Hp 3600, lp 1800 rpm
28 - Softening temperature
29 - Start-up
30 - 3600/3600 rpm
31 - Future coal
32 - Steam turbine
33 - Gas turbine
34 - Inches of water
35 - Crushers

# factors hold down energy supply cost




**PLANT UTILIZATION** has varied trend over the years. It depends on water availability during year, ratio of hydro to thermal capacity and the excess of installed capacity over peak demand. Increasing reserve capacity drops plant utilization during the late 1950's




**ENERGY CONSUMED PER CAPITA** points up increasing reliance on electric energy for all uses. Installed reserve capacity zooms to peak during great depression in 30's, plunges to nadir during post-World-War-II recovery, shows re-establishment during 50's to a higher level

# 1961 design survey: typical hydroelectric

Compiled by B G A Skrotzki, Associate Editor

| Project Number | Company or government agency | Design or consulting engineers | Project name | New or redeveloped[1] | River | State | Project started, year | Dam, type[2] | Crest length, ft | Max. height, ft | Type of installation[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | EASTERN STATES | | | | | | | | | | |
| 1 | Alabama Power Co | Southern Services, Inc | Lewis Smith Dam | New | Sipsey Fork of Black Warrior | Ala | 1957 | RFEC | 2,200 | 300 | I |
| 2 | Alabama Power Co | Southern Services, Inc | Lock No. 3 | New | Coosa | Ala | 1962 | CG&EF | ..... | ..... | I |
| 3 | Alabama Power Co | Southern Services, Inc | Logan Martin | New | Coosa | Ala | 1960 | CG&EF | 6,026 | 100 | O |
| 4 | Alabama Power Co | Southern Services, Inc | John Hollis Bankhead | New | Black Warrior | Ala | 1961 | ..... | ..... | ..... | I |
| 5 | Alabama Power Co | Southern Services, Inc | Weiss Dam | New | Coosa | Ala | 1958 | CG&EF | 12,700 | 92 | I |
| 6 | Appalachian Power Co | Ebasco Services Inc | Smith Mountain Lower | New | Roanoke | Va | 1960 | CG | 970 | 100 | O |
| 7 | Appalachian Power Co | Ebasco Services Inc | Smith Mountain Upper | New | Roanoke | Va | 1960 | CA | 815 | 240 | O |
| 8 | Duke Power Co | Charles T Main, Inc | Cowans Ford | New | Catawba | NC | 1959 | CG&EF | 6,776 | 130 | O |
| 9 | Georgia Power Co | | North Highlands | Red | Chattahoochee | Ga | 1960 | MG | 705 | 35 | S |
| 10 | Hoague-Sprague Corp | Anderson-Nichols Co, Inc | Davis Boxboard Div | Red | Contoocook | NH | 1960 | RF | 300 | 14 | I |
| 11 | Power Authority of the State of N Y[7] | Uhl, Hall & Rich | Robert Moses Niagara | New | Niagara | NY | 1958 | ..... | ..... | ..... | S |
| 12 | Power Authority of the State of N Y[7] | Uhl, Hall & Rich | Lewiston Pump Generating | New | Niagara | NY | 1958 | CG[12] | 954[13] | 115 | S |
| 13 | Susquehanna Power Co | Philadelphia Electric Co | Conowingo | Red | Susquehanna | Md | 1926 | CG | 4,648 | 102 | I,O |
| 14 | Tennessee Valley Authority | | Melton Hill Dam | New | Clinch | Tenn | 1960 | CG | 1,072 | 80 | I |
| 15 | Tennessee Valley Authority | | Wheeler Dam | New | Tennessee | Ala | 1933 | CG | 6,342 | 72 | O |
| 16 | Tennessee Valley Authority | | Wilson Dam | New | Tennessee | Ala | 1918 | CG | 4,535 | 137 | I,O |
| 17 | U S Army Engineers[7] | U S Army Engrs; Harza Engrg Co | Hartwell | New | Savannah | Ga & SC | 1955 | CG&EF | 15,262 | 240 | O |
| 18 | Virginia Electric & Power Co | Stone & Webster Engrg Corp | Gaston | New | Roanoke | NC & Va | 1960 | REF | 3,600 | 105 | O |
| 19 | Yadkin, Inc | Aluminum Co of America, Engrg Div. | Tuckertown | New | Yadkin | NC | 1960 | CG&RF | 1,255 | 76 | I |
| | CENTRAL STATES | | | | | | | | | | |
| 20 | Grand River Dam Authority | W R Holway & Associates | Markham Ferry | New | Grand | Okla | 1962 | CG&EF | 3,200 | 90 | O |
| 21 | Union Electric Co | | Taum Sauk (Pump-storage) | New | | Mo | 1960 | CG[14] | 390[14] | 60[14] | S |
| | | | | | | | | RFCF[15] | 6,600[15] | 100[15] | S |
| 22 | U S Army Engineers, Tulsa | Sverdrup & Parcel & Assoc, Inc | Eufala Dam | New | Canadian (South) | Okla | 1956 | CG&EF | 3,200 | 114 | I |
| 23 | U S Army Engineers, Ft Worth, Tex | Harza Engineering Co | McGee Bend | New | Angelina | Texas | 1956 | REF | 11,300 | 120 | I |
| | MOUNTAIN STATES | | | | | | | | | | |
| 24 | U S Bureau of Reclamation | | Flaming Gorge | New | Green | Utah | 1958 | CA | 1,180 | 502 | I |
| 25 | U S Bureau of Reclamation | | Hoover | New | Colorado | Ariz-Nev | 1931 | CA | 1,244 | 726 | I |
| 26 | U S Bureau of Reclamation | | Lower Molina | New | ..... | Colo | 1959 | ..... | ..... | ..... | I |
| 27 | U S Bureau of Reclamation | | Upper Molina | New | ..... | Colo | 1959 | ..... | ..... | ..... | I |
| 28 | U S Bureau of Reclamation | | Yellowtail | New | Big Horn | Mont | 1961 | CA | 1,450 | 520 | I |
| 29 | City & County of Denver[7] | Tipton and Kalmbach Inc | Williams Fork | New | Williams Fork | Colo | 1956 | CA | 675 | 215 | I |
| 30 | GarKane Power Association, Inc | Intermountain Engineers Inc | Boulder Creek No. 3 | New | Boulder West Fork Creek | Utah | 1960 | RERF | 204 | 42 | I |
| 31 | Montana Power Co | Ebasco Services Inc | Thompson Falls | Red | Clarks Fork | Mont | 1915 | CG | 1,000 | 35 | I,S |
| 32 | Montana Power Co | Bechtel Corp | Buffalo Rapids No 4 | New | Flathead | Mont | ....[11] | CG&EF | 1,950 | 130 | S |
| 33 | Montana Power Co | Bechtel Corp | Buffalo Rapids No 2 | New | Flathead | Mont | ....[11] | CG&EF | 2,148 | 110 | S |
| 34 | Rio Blanco Ranch Co | | Rio Blanco | Red | White | Colo | 1959 | EF | 500 | 17 | I |
| 35 | U S Army Engineers, Omaha | Erik Floor and Associates | Fort Peck No 2 | New | Missouri | Mont | 1933 | HF | 21,026 | 250.5 | I |
| | PACIFIC COAST STATES | | | | | | | | | | |
| 36 | PUD No 1 of Chelan County[7] | Stone & Webster Engrg Corp | Rocky Reach | New | Columbia | Wash | 1956 | CGS&B | 3,100 | 127 | I |
| 37 | PUD No 1 of Douglas County | Bechtel Corp | Wells[11] | New | Columbia | Wash | 1963 | EF | 1,430 | ..... | I |
| 38 | PUD of Grant County[7] | Harza Engineering Co | Priest Rapids | New | Columbia | Wash | 1956 | CG&EF | 10,138 | 178 | I |
| 39 | PUD of Grant County[7] | Harza Engineering Co | Wanapum | New | Columbia | Wash | 1959 | CG&EF | 8,320 | 185 | I |
| 40 | Eugene Water & Electric Board | Bechtel Corp | Carmen-Smith (Smith R) | New | Smith | Ore | 1960 | REF | 1,100 | 215 | .... |
| 41 | Eugene Water & Electric Board | Bechtel Corp | Carmen-Smith (Carmen) | New | McKenzie | Ore | 1960 | REF | 2,180[9] | 25[9] | S |
| 42 | Eugene Water & Electric Board | Bechtel Corp | Carmen-Smith (Trail Bridge) | New | McKenzie | Ore | 1960 | REF | 620 | 98 | S |
| 43 | Idaho Power Co | International Engineering Co | Oxbow | New | Snake | Ore, Idaho | 1955 | RFCC | 1,650 | 200 | S |
| 44 | Oroville-Wyandotte Irrigation Dist | Bechtel Corp | South Fork-Woodleaf | New | South Fork Feather | Calif | 1960 | REF | 1,200 | 289 | O |
| 45 | Oroville-Wyandotte Irrigation Dist | Bechtel Corp | South Fork-Forbestown | New | South Fork Feather | Calif | 1960 | CA | 256 | 80 | O |
| 46 | Oroville-Wyandotte Irrigation Dist | Bechtel Corp | South Fork-Kelly Ridge | New | South Fork Feather | Calif | 1960 | REF | 1,700 | 57 | I |
| 47 | Pacific Gas & Electric Co | | De Sabla | Red | Butte Creek | Calif | 1961 | EF | 1,035 | 53 | O |
| 48 | Pacific Gas & Electric Co | | Kings River | New | Kings | Calif | 1959 | CA | 190 | 169 | S |
| 49 | Pacific Gas & Electric Co | | Stanislaus | Red | Stanislaus | Calif | 1960 | TC | 174 | 24 | O |
| 50 | Portland General Electric Co | Bechtel Corp | Round Butte | New | Deschutes | Ore | 1961 | RF | 1,320 | 440 | O |
| 51 | Sacramento Municipal Utility Dist | Bechtel Corp | Jaybird | New | Silver Creek | Calif | 1958 | CA | 520 | 168 | O |
| 52 | Sacramento Municipal Utility Dist | Bechtel Corp | Camino No 1 | New | South Fork American | Calif | 1959 | CA | 440 | 118 | O |
| 53 | Sacramento Municipal Utility Dist | Bechtel Corp | Union Valley | New | Silver Creek | Calif | 1959 | REF | 1,860 | 428 | O |
| 54 | Seattle City Light | | Boundary | New | Pend Oreille | Wash | 1962 | A&G | 975 | 385 | U |
| 55 | Tacoma Dept of Pub Utilities, Light Div[7] | Harza Engineering Co | Mayfield | New | Cowlitz | Wash | 1955 | A&G | 850 | 185 | I |

[1] New projects have not been previously developed. Redeveloped projects have new equipment on a previously developed site.

[2] Dam types:
A&G - arch and gravity
CA - concrete arch
CG - concrete gravity
CG&EF - concrete gravity and earth fill
CG&RF - concrete gravity and rock fill
CGS&B - concrete gravity, slab and buttress
EF - earth fill
G - gravity
HF - hydraulic fill
MG - masonry gravity
REF - rolled earth fill
RERF - rolled earth filled with rubble masonry core wall
RF - rock fill
RFa - rock faced
RFCC - rock fill with clay core
RFCF - rock fill with concrete face
RFEC - rock fill with earth core
TC - timber crib

[3] I - indoor S - semioutdoor
O - outdoor U - underground

[4] Manufacturers
AC - Allis-Chalmers Mfg Co
AE - American Elin Corp
AJ - A Johnson & Co, Ltd
ASEA - ASEA Electric, Inc (Sweden)
BB - Brown Boveri Corp
BL - Baldwin-Lima-Hamilton Corp
CAC - Canadian Allis-Chalmers Ltd
CGE - Canadian General Electric Co
CWC - Canadian Westinghouse Co Ltd
DEC - Dominion Engineering Co Ltd
EC - Elliott Co

# plants in the United States and Canada

| Initial operation, year | Initial capacity, hp | Added capacity, No. of units | Added capacity, year | Ultimate capacity, hp | No. of units installed | Hydro-turbine capacity, hp | Hydro-turbine type | Speed, rpm | Static head, ft | Design head, ft | Hydro-turbine manufacturer[4] | Governor manufacturer[4] | Scroll case, concrete or steel | Penstock valve, type | Generator capacity, kva | Design power factor | Kilovolts | Synchronizing, manual or automatic | Thrust-bearing location[5] | Generator manufacturer[4] | Project Number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1961 | 105,560 | 1 | 1962 | 211,120 | 2 | 111,500 | Francis | 138.5 | 233-255 | 210 | AC | AC | Welded pl st | Head gates | 87,500 | 0.90 | 13.8 | Both | BG | GE | 1 |
| 1965 | 57,900 | 2 | 1965 | 86,860 | 3 | 33,500 | Propeller | 81.8 | 45-40 | 35 | NN | W | Concrete | Head gates | 27,000 | 0.80 | 13.8 | Both | BG | AC | 3 |
| 1964 | 171,900 | 3 | 1964 | 171,900 | 3 | 59,000 | Propeller | 90 | 64-69 | 56 | AC | W | Concrete | Head gates | 47,500 | 0.90 | 13.8 | Both | BG | AC | 4 |
| 1963 | 60,500 | 1 | 1963 | 60,500 | 1 | 60,500 | Propeller | 102.8 | 68-65 | 66.5 | AC | W | Concrete | Head gates | 47,500 | 0.80 | 13.8 | Both | BG | AC | 4 |
| 1961 | 117,600 | 3 | 1961 | 117,600 | 3 | 39,100 | Propeller | 90 | 53-59 | 49 | AC | W | Concrete | Head gates | 32,500 | 0.90 | 11.5 | Both | BG | WE | 5 |
| 1962 | 47,500[16] | 2 | 1962 | 47,500[16] | 2 | 23,750 | Francis | ..... | ..... | ..... | .... | .... | ..... | ..... | 23,750[16] | ..... | ..... | ..... | ..... | ..... | 6 |
| 1963 | 582,000 | 4 | 1963 | 790,000 | 2 | 204,000 | Francis | ..... | ..... | 179 | .... | .... | ..... | ..... | 150,100[16] | ..... | ..... | ..... | ..... | ..... | 7 |
| | | | | | 2 | 87,000 | Francis | 105.9 | ..... | 180 | .... | .... | ..... | ..... | 66,025[16] | ..... | ..... | ..... | ..... | ..... | |
| | | | | | As pumps these units drew 99,000 hp to deliver 4500 cfs against an 180-ft head | | | | | | | | | | | | | | | | |
| 1963 | 363,000 | 3 | 1963 | 484,000 | 3 | 121,000 | Kaplan | 105.9 | 112-87 | 92 | AC | W | Concrete | Head gates | 87,500 | 0.95 | 13.8 | Both | BG | WE | 8 |
| 1901 | 10,000[10] | 4 | 1962 | 41,800 | 3 | 13,000 | Propeller | 100 | 40 | 35 | AC | W | Concrete | Head gates | 11,500 | 0.80 | 4.2 | Both | AG | GE | 9 |
| | | | | | 1 | 2,800 | Propeller | 225 | 40 | 35 | JL | W | Concrete | Head gates | 2,500 | | | | | | |
| ..... | 80 | 1 | 1960 | ..... | 1 | 700 | Francis | 150 | 16-21 | 21 | MS | .... | Concrete | Slide gate | 500 | 1.00 | 0.55 | Manual | HS | WE | 10 |
| 1961 | 2,600,000 | 13 | 1961 | 2,600,000 | 13 | 200,000 | Francis | 120 | 292-315 | 300 | BL&NN | W | Welded pl st | Head gates | 167,000 | 0.90 | 13.8 | Both | BG | WE | 11 |
| 1961 | 336,000 | 12 | 1961 | 336,000 | 12 | 28,000 | Francis | 112.5 | 56-107 | 75 | AC | PB | Welded pl st | Head gates | 25,000 | 0.80 | 13.8 | Both | BG | AC | 12 |
| | | | | | Run in reverse as 37,500-hp pumps with 3400-cfs capacity at 85-ft head. Head range 56 to 107 ft | | | | | | | | | | | | | | | | |
| 1928 | 378,000 | 4 | 1964-5 | 718,000 | 11 | 85,000 | Propeller | 120 | 89-85 | 86 | AC | W | Welded pl st | Head gates | 61,800 | 0.90 | 13.8 | Both | BG | WE | 13 |
| 1963 | 99,400 | 2 | 1963 | 99,400 | 2 | 49,700 | Kaplan | 85.7 | 58-44 | 47 | BL | W | Concrete | ..... | 40,000 | 0.90 | 13.8 | Auto | BG | ASEA | 14 |
| 1936 | 360,000 | 3 | 1962 | 504,900 | 11 | 48,300 | Propeller | 78.3 | 52-40 | 44 | BL | W | Concrete | ..... | 36,000 | 0.90 | 13.8 | Auto | BG | AE | 15 |
| 1925 | 610,000 | 3 | 1961 | 833,800 | 21 | 74,600 | Propeller | 105.9 | 98-67 | 89 | AC | W | Welded pl st | ..... | 60,000 | 0.90 | 13.8 | Auto | BG | BB | 16 |
| 1962 | 366,000 | 4 | 1962 | ..... | 4 | 91,500 | Francis | 100 | 187-144 | 170 | NN | W | Plate steel | Head gates | 73,333 | 0.90 | 13.8 | Both | BG | WE | 17 |
| ..... | ..... | ... | 1962 | 287,000 | 1 | 77,000 | Kaplan | 100 | 74-62 | 67 | NN | W | Concrete | Wheel gate | 55,600 | 0.80 | 14.4 | Auto | BG | WE | 18 |
| | | | | | 3 | 70,000 | Propeller | | | | | | | Slide gate | | | | | | | |
| 1962 | 51,000 | 3 | 1962 | 51,000 | 3 | 17,000 | Kaplan | 138.5 | 52-61 | 55 | NN | W | Concrete | Head gates | 15,555 | 0.90 | 6.9 | Both | BG | WE | 19 |
| 1964 | 140,000 | 4 | 1964 | 140,000 | 4 | 35,000 | Kaplan | 100 | 51-65 | 51 | .... | .... | Concrete | Head gates | 30,000 | 0.90 | 13.8 | Both | BG | ..... | 20 |
| 1963 | 482,000 | 2 | 1963 | 482,000 | 2 | 241,000 | Francis | 200 | 862-754 | 790 | AC | W | Welded pl st | Spherical | 204,000 | 1.00 | 13.8 | Auto | BG | GE | 21 |
| | | | | | Run in reverse as 275,000-hp pumps del 2650 cfs against 764-ft head. Head range 764 to 875 ft | | | | | | | | | | | | | | | | |
| 1964 | 124,500 | 3 | 1964 | 124,500 | 3 | 41,500 | Francis | 100 | 70-125 | 96 | NN | .... | Riveted pl st | Head gates | 31,579 | 0.95 | 13.8 | Auto | BG | WE | 22 |
| ..... | 82,600 | ... | 1965 | 82,600 | ... | 82,600 | Kaplan | 120 | 53-88 | 70 | AC | .... | Concrete | Head gates | 27,368 | 0.95 | 13.8 | Both | BG | EC | 23 |
| 1963 | 150,000 | 3 | 1963 | 150,000 | 3 | 50,000 | Francis | 240 | 260-440 | 400 | JL | W | Welded pl st | Head gates | 40,000 | 0.90 | 11.5 | Both | AG | WE | 24 |
| 1936 | 422,000 | 1 | 1961 | 1,857,000 | 19 | 115,000 | Francis | 180 | 400-585 | 520 | BL | PB | Welded pl st | Butterfly | 100,000 | 0.95 | 16.5 | Auto | AG | AC | 25 |
| 1961 | 6,800 | 1 | 1961 | 6,800 | 1 | 6,800 | Impulse | 450 | 1370-1614 | 1400 | AC | W | ..... | ..... | 5,400 | 0.90 | 4.16 | Both | HS | EC | 26 |
| 1961 | 12,000 | 1 | 1961 | 12,000 | 1 | 12,000 | Impulse | 600 | 2360-2688 | 2490 | AC | W | ..... | ..... | 9,600 | 0.90 | 4.16 | Both | HS | EC | 27 |
| 1966 | 280,000 | 4 | 1966 | 280,000 | 4 | 70,000 | Francis | 225 | 275-467 | 440 | .... | .... | Welded pl st | Head gates | 52,632 | 0.95 | 13.8 | ..... | AG | ..... | 28 |
| 1959 | 4,250 | 1 | 1959 | 4,250 | 1 | 4,250 | Francis | 450 | 119 | 155 | JL | EM | Plate steel | Gate[8] | 3,158 | 0.95 | 3.0 | Auto | AG | ..... | 29 |
| 1958 | 3,950 | 1 | 1961 | 5,925 | 3 | 1,975 | Impulse | 900 | 1400 | 1527 | BL | BL | Cast steel | Slide gate | 1,750 | ..... | 2.4 | Both | HS | EC | 30 |
| 1915 | 47,000 | 2 | ..... | 87,000 | 8 | 27,500 | ..... | 109.1 | 64-36 | 52 | .... | .... | Concrete | Head gates | 17,500 | 0.90 | 13.8 | Both | BG | ..... | 31 |
| 1964[11] | 168,000 | 2 | 1964-66 | 168,000 | 2 | 84,000 | Kaplan | 100 | 66-82 | 82 | .... | .... | Concrete | Head gates | 66,666 | 0.90 | 13.8 | Both | BG | ..... | 32 |
| 1968[11] | 168,000 | 2 | 1968-70 | 168,000 | 2 | 84,000 | Kaplan | 100 | 61-82 | 82 | .... | .... | Concrete | Head gates | 66,666 | 0.90 | 13.8 | Both | BG | ..... | 33 |
| 1959 | 60 | ... | 1959 | 60 | 1 | 60 | ..... | 483 | 30-27 | 27 | JL | W | Riveted pl st | Slide gate | 50 | 0.80 | 0.48 | ..... | ..... | EM | 34 |
| 1943 | 120,000 | 2 | 1961 | 260,000 | 5 | 55,000 | Francis | 128.6 | 121-215 | 170 | AC | W | Riveted pl st | Butterfly | 42,105 | 0.95 | 13.8 | Both | BG | EC | 35 |
| 1961 | 980,000 | 7 | 1961 | 1,540,000 | 7 | 140,000 | Kaplan | 90 | ..... | 92 | AC | W | Concrete | Head gates | 107,000 | 0.95 | 15.0 | Both | BG | GE | 36 |
| 1966 | 224,000 | 2 | 1966 | 896,000 | 2 | 112,000 | Kaplan | 85.7 | ..... | 64.4 | .... | .... | Concrete | ..... | 74,300 | 0.95 | 14.4 | Both | AG | ..... | 37 |
| 1959 | 1,140,000 | 10 | 1961 | 1,824,000 | 10 | 114,000 | Kaplan | 85.7 | 32-84 | 78 | EE | PB | Concrete | Slide gate | 83,000 | 0.95 | 13.8 | Manual | BG | EE | 38 |
| 1963 | 1,200,000 | 10 | 1963 | 1,920,000 | 10 | 120,000 | Kaplan | 85.7 | 30-87 | 80 | DEC | PB | Concrete | Slide gate | 87,500 | 0.95 | 13.8 | Manual | BG | GE | 39 |
| 1962 | ..... | ... | 1962 | ..... | ... | ..... | ..... | ..... | ..... | ..... | .... | .... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 40 |
| 1962 | 112,000 | 2 | 1962 | 112,000 | 2 | 56,000 | Francis | 240 | 523 | 359 | AC | W | Welded pl st | Butterfly | 42,100 | 0.95 | 11.5 | Both | AG | WE | 41 |
| 1962 | 11,700 | 1 | 1962 | 11,700 | 1 | 11,700 | Kaplan | 212 | 76 | 67 | AC | W | Welded pl st | Bypass | 10,500 | 0.95 | 11.5 | Both | AG | GE | 42 |
| 1961 | 292,000 | 4 | 1961 | 438,000 | 4 | 73,000 | Francis | 94.8 | 125-110 | 115 | NN | W | Welded pl st | Head gates | 52,778 | 0.90 | 13.8 | Both | BG | WE | 43 |
| 1962 | 71,000 | 1 | 1962 | 71,000 | 1 | 71,000 | Impulse | 327 | 1493-1480 | 1443 | AC | W | Welded pl st | Rotary | 58,000 | 0.90 | 13.8 | Both | AG | AC | 44 |
| 1962 | 39,000 | 1 | 1962 | 39,000 | 1 | 39,000 | Francis | 450 | 835-818 | 795 | AC | W | Welded pl st | Butterfly | 32,000 | 0.90 | 11.5 | Both | AG | AC | 45 |
| 1962 | 13,000 | 1 | 1962 | 13,000 | 1 | 13,000 | Francis | 720 | 667-645 | 628 | AC | W | Welded pl st | Butterfly | 11,000 | 0.90 | 4.16 | Both | AG | AC | 46 |
| 1903 | 23,500 | 1 | 1962 | 25,000 | 1 | 25,000 | Impulse | 450 | 1535-1517 | 1472 | PB | PB | Cast, pl st | Spherical | 20,500 | 0.90 | 6.9 | Manual | HS | GE | 47 |
| 1962 | 60,000 | 1 | 1962 | 60,000 | 1 | 60,000 | Francis | 360 | 809-730 | 738 | PB | PB | Welded pl st | Butterfly | 49,000 | 0.90 | 13.8 | Both | AG | WE | 48 |
| 1908 | 56,000 | 1 | 1962 | 113,000 | 1 | 113,000 | Impulse | 257 | 1527-1496 | 1493 | AC | W | Welded pl st | Spherical | 91,000 | 0.90 | 13.8 | Both | AG | GE | 49 |
| ..... | 345,000 | 3 | 1964 | 345,000 | 3 | 115,000 | Francis | 180 | 372-280 | 365 | AC | W | Welded pl st | Butterfly | 300,000 | 0.90 | 13.8 | Auto | BG | AC | 50 |
| 1961 | 88,000 | 1 | 1962 | 176,000 | 2 | 88,000 | Impulse | 300 | 1530 | 1432 | AC | AC | ..... | Rotary | 70,000 | 0.95 | 13.8 | Auto | AG | GE | 51 |
| 1962 | 100,000 | 1 | 1962 | 200,000 | 1 | 100,000 | Francis | 360 | 1065 | 1000 | PB | PB | Welded pl st | Rotary | 75,000 | 0.95 | 13.8 | Auto | AG | GE | 52 |
| 1963 | 53,000 | 1 | 1963 | 53,000 | 1 | 53,000 | Francis | 277 | 234-416 | 360 | JL | PB | Welded pl st | Butterfly | 35,000 | 0.95 | 13.8 | Auto | AG | EC | 53 |
| 1967 | 750,000 | 6 | 1967 | 1,125,000 | 6 | 125,000 | Francis | 120 | 250-270 | 250 | .... | .... | Welded pl st | Head gates | 100,000 | 0.90 | 13.8 | Both | BG | ..... | 54 |
| 1962 | 165,000 | 3 | ..... | 220,000 | 1 | 55,000 | Francis | 138 | 185-175 | 182 | AC | PB | Welded pl st | Head gates | 45,000 | 0.90 | 13.8 | Both | BG | AC | 55 |

EE - English Electric Co Ltd
EEC - English Electric Co of Canada Ltd
EM - Electric Machinery Mfg Co
GE - General Electric Co
GGG - Gilbert Gilkes & Gordon Ltd
JL - James Leffel & Co
H - Hitachi, Ltd
KMW - KMW of Sweden
MS - S Morgan Smith Co
NN - Newport News Shipbuilding & Drydock Co
PB - Pelton Div, Baldwin-Lima-Hamilton Corp
W - Woodward Governor Co
WE - Westinghouse Electric Corp

5 Thrust bearing
AG - above generator rotor
BG - below generator rotor

HS - horizontal shaft unit
6 two runners for each turbine
7 listed 1958 survey, revised data
8 fixed wheel
9 diversion dam above Smith River
10 all removed in redevelopment
11 subject to receiving FPC license
12 power dam
13 power dam, reservoir embankment is 34,625 ft
14 lower dam
15 upper dam
16 kilowatts

# Typical hydroelectric plants continued

| Project Number | Company or government agency | Design or consulting engineers | Project name | New or redeveloped[1] | River | State | Project started, year | Dam, type[2] | Crest length, ft | Max. height, ft | Type of installation[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | PACIFIC COAST STATES, Cont | | | | | | | | | | |
| 56 | U S Army Engineer Dist, Portland, Ore[7] | ..... | Cougar Reservoir ..... | New | South Fork McKenzie ..... | Ore | 1956 | RF | 1,600 | 445 | I |
| 57 | U S Army Engineer Dist, Portland, Ore[7] | ..... | Hills Creek Reservoir ..... | New | Middle Fork Willamette ..... | Ore | 1956 | EF | 2,150 | 338 | I |
| 58 | U S Bureau of Reclamation ..... | ..... | Clear Creek ..... | New | ..... | Calif | 1957 | ..... | ..... | ..... | I |
| 59 | U S Bureau of Reclamation ..... | ..... | Spring Creek ..... | New | ..... | Calif | 1957 | ..... | ..... | ..... | I |
| 60 | U S Bureau of Reclamation ..... | ..... | Trinity ..... | New | Trinity ..... | Calif | 1960 | EF | 2,450 | 537 | I |
| 61 | Chatanika Power Co, Inc ..... | Roy W Johnson ..... | Chatanika ..... | New | Chatanika ..... | Alaska | 1958 | RF | 100 | 8 | I |
| | CANADA | | | | | | | | | | |
| 62 | British Columbia Power Commission .. | ..... | Clayton Falls ..... | New | Clayton Falls Creek ..... | BC | 1961 | G | 80 | 10 | I |
| 63 | Calgary Power Ltd ..... | Montreal Engineering Co Ltd ..... | Brazeau Storage & Power Devel | New | Brazeau ..... | Alta | 1959 | REF | 6,970 | 203 | I |
| 64 | Eldorado Mining & Refining Ltd ..... | Montreal Engineering Co Ltd ..... | Waterloo Lake ..... | New | Charlot ..... | Sask | 1960 | REF | 1,325 | 63 | I |
| 65 | Hydro-Electric Power Comm of Ontario . | ..... | Otter Rapids ..... | New | Abitibi ..... | Ont | 1958 | CG&EF | 1,800 | 120 | I |
| 66 | Hydro-Electric Power Comm of Ontario . | ..... | Little Long ..... | New | Mattagami ..... | Ont | 1960 | CG&EF | 27,000 | 60 | I |
| 67 | Hydro-Electric Power Comm of Ontario[7]. | ..... | Manitou Falls ..... | New | English ..... | Ont | 1953 | CG&EF | 1,092 | 55 | I |
| 68 | Hydro-Electric Power Comm of Ontario[7]. | ..... | Red Rock Falls ..... | New | Mississagi ..... | Ont | 1958 | CG | 952 | 85 | I |
| 69 | Hydro-Electric Power Comm of Ontario[7]. | ..... | Robert H Saunders ..... | New | St Lawrence ..... | Ont | 1954 | CG&EF | 20,200 | 110 | S |
| | | | | | | | | CG&EF | 2,250 | 100 | |
| 70 | Hydro-Electric Power Comm of Ontario[7]. | ..... | Sir Adam Beck-Niagara No 2 .. | New | Niagara ..... | Ont | 1950 | ..... | ..... | ..... | I |
| 71 | Hydro-Electric Power Comm of Ontario[7]. | ..... | Sir Adam Beck, Niagara ..... Pumping-Generating Sta ..... | New | Niagara ..... | Ont | 1953 | EF&RF | 24,987 | 68 | O |
| 72 | Manitoba Hydro-Electric Board ..... | H G Acres & Co, Ltd ..... | Kelsey ..... | New | Nelson ..... | Man | 1957 | RF | 954 | 120 | I |
| 73 | Northern Canada Power Comm ..... | Montreal Engineering Co Ltd ..... | Snare Falls ..... | New | Snare ..... | NWT | 1959 | EF | 480 | 65 | I |
| 74 | Nova Scotia Power Commission ..... | ..... | Weymouth Falls ..... | New | Sissiboo ..... | NS | 1958 | REF | 1,768 | 101 | I |
| 75 | Nova Scotia Power Commission ..... | ..... | Sissiboo Falls ..... | New | Sissiboo ..... | NS | 1958 | CG&EF | 1,600 | 80 | I |
| 76 | Corp of City of Revelstoke ..... | Sir Wm Halcrow & Partners Ltd ..... | Cranberry Creek ..... | New | Cranberry Creek ..... | BC | 1960 | EF,RFa | 1,460 | 42 | I |
| 77 | Saskatchewan Power Corp ..... | Crippen Wright Engineering ..... | Squaw Rapids ..... | New | Saskatchewan ..... | Sask | 1959 | EF | 2,000 | 110 | I |
| 78 | Iron Ore Co of Canada ..... | Montreal Engineering Co Ltd ..... | Menihek ..... | New | Ashuanipi ..... | NF | ..... | P&G | 1,000 | 50 | I |

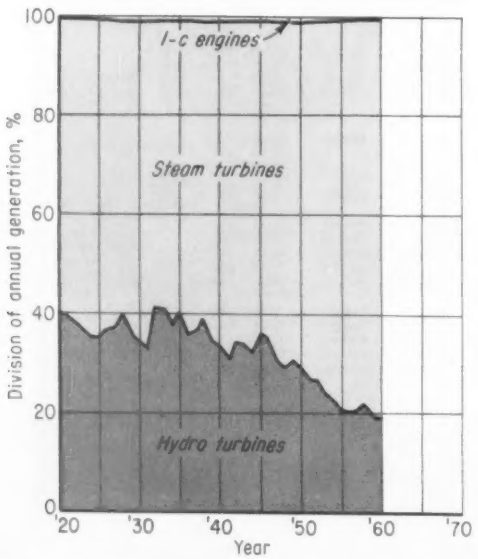
[1] New projects have not been previously developed. Redeveloped projects have new equipment on a previously developed site.

[2] Dam types:
CA - concrete arch
CG - concrete gravity
CG&EF - concrete gravity and earth fill
CG&RF - concrete gravity and rock fill
CGS&B - concrete gravity, slab and butress
EF - earth fill
G - gravity
HF - hydraulic fill
MG - masonry gravity
P&G - piers and gates
RERF - rolled earth filled with rubble masonry core wall
REF - rolled earth fill
RF - rock fill
RFa - rock faced
RFCC - rock fill with clay core
RFCF - rock fill with concrete face
RFEC - rock fill with earth core
TC - timber crib

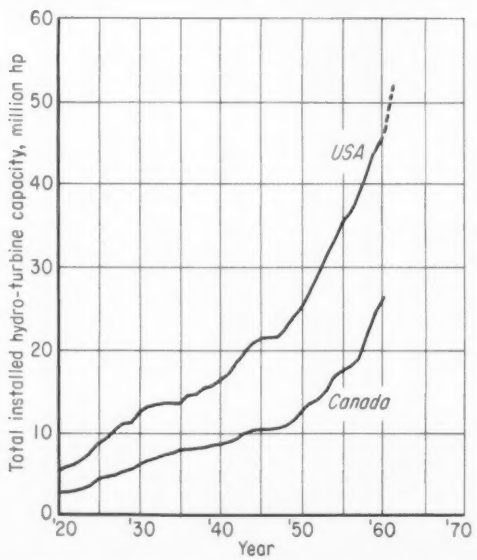
[3] I - indoor S - semioutdoor
O - outdoor U - underground

[4] Manufacturers
AC - Allis-Chalmers Mfg Co
AE - American Elln Corp
AJ - A Johnson & Co, Ltd
ASEA - ASEA Electric, Inc (Sweden)
BB - Brown Boveri Corp
BL - Baldwin-Lima-Hamilton Corp
CAC - Canadian Allis-Chalmers Ltd
CGE - Canadian General Electric Co
CWC - Canadian Westinghouse Co Ltd
DEC - Dominion Engineering Co Ltd
EC - Elliott Co

# Pattern of growth leads to equipment consolidations




**GENERATION DIVISION** in utility plants shows shrinking share produced by hydroelectric plants despite steadily growing hydro capacity. Part of this is caused by smaller percentage of hydro capacity and increasing tendency of the utilities to use their hydro for peaking




**HYDRAULIC-TURBINE CAPACITY** in both U.S. and Canada has enjoyed steady growth with increasing demands for energy. Trend shows no sign of slackening despite need to go to remoter sites for development and the current trend to install larger steam stations

| Initial operation, year | Initial capacity, hp | Added capacity, No. of units | Added capacity, year | Ultimate capacity, hp | No. of units installed | Hydro-turbine capacity, hp | Hydro-turbine type | Speed, rpm | Static head, ft | Design head, ft | Hydro-turbine manufacturer[4] | Governor manufacturer[4] | Scroll case, concrete or steel | Penstock valve, type | Generator capacity, kva | Design power factor | Kilovolts | Synchronizing, manual or automatic | Thrust-bearing location[5] | Generator manufacturer[4] | Project Number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1963 | 34,500 | ... | ..... | 34,500 | ... | ..... | Francis | 400 | 448-263 | 324 | JL | W | Welded pl st | Butterfly | 26,316 | 0.95 | 6.9 | Manual | AG | EC | 56 |
| 1962 | 43,400 | ... | ..... | 43,400 | ... | ..... | Francis | 277 | 320-187 | 256 | PB | W | Welded pl st | Butterfly | 31,578 | 0.95 | 6.9 | Manual | AG | BB | 57 |
| 1963 | 187,000 | 2 | 1963 | 187,000 | 2 | 93,500 | Francis | 225 | 500-670 | 535 | H | PB | Welded pl st | Butterfly | 74,444 | 0.90 | 13.8 | Both | AG | GE | 58 |
| 1963 | 210,000 | 2 | 1963 | 210,000 | 2 | 105,000 | Francis | 225 | 455-646 | 566 | NN | W | Welded pl st | Butterfly, hd gt | 83,333 | 0.90 | 13.8 | Both | AG | AC | 59 |
| 1963 | 140,000 | 2 | 1963 | 140,000 | 2 | 70,000 | Francis | 200 | 222-483 | 426-334[6] | EE | W | Welded pl st | Butterfly, hd gt | 55,555 | 0.90 | 13.8 | Auto | AG | GE | 60 |
| 1959 | 6,700 | 1 | 1959 | 6,700 | 1 | 6,700 | Impulse | 360 | 555 | 529 | PB | W | ..... | Gate | 6,250 | 0.90 | 4.16 | Manual | HS | EC | 61 |
| 1960 | 1,050 | 1 | 1960 | 2,100 | 1 | 1,050 | Francis | 900 | 233-250 | 238 | GGG | W | Cast steel | Butterfly | 780 | 0.9 | 2.4 | Manual | HS | GE | 62 |
| ..... | 200,000 | 1 | 1964 | ..... | ... | 200,000 | Francis | ..... | ..... | ..... | ..... | .... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 63 |
| 1961 | 10,000 | 1 | 1961 | 10,000 | 1 | 10,000 | Kaplan | 225 | 69-70 | 63-70 | CAC | W | Welded pl st | Head gates | 11,250 | 0.85 | 6.9 | Both | AG | CWC | 64 |
| 1961 | 240,000 | 4 | 1961 | 480,000 | 4 | 60,000 | Propeller | 138.4 | 106-108 | 107 | CAC | W | Welded pl st | Head gates | 46,000 | 0.95 | 13.8 | Both | BG | CGE | 65 |
| 1963 | 168,000 | 2 | 1963 | 336,000 | 2 | 84,000 | Propeller | 94.7 | 85-90 | 90 | EE | W | Welded pl st | Head gates | 64,000 | 0.95 | 13.8 | Both | BG | ..... | 66 |
| 1956 | 74,000 | 1 | 1958 | 92,500 | 5 | 18,500 | Propeller | 150 | 59-44 | 54 | DEC | W | Concrete | Head gates | 16,000 | 0.90 | 13.8 | Auto | BG | CGE | 67 |
| 1960 | 53,000 | 2 | 1960 | 53,000 | 2 | 26,500 | Propeller | 180 | 85-95 | 93 | DEC | W | Welded pl st | Head gates | 22,500 | 0.90 | 13.8 | Both | BG | CGE | 68 |
| 1958 | 1,200,000 | ... | ..... | 1,200,000 | 8 | 75,000 | Propeller | 94.7 | 87-78 | 81 | EEC | W | Concrete | Head gates | 60,000 | 0.95 | 13.8 | Auto | BG | CWC | 69 |
| | | | | | 8 | 75,000 | Propeller | 94.7 | 87-78 | 81 | EEC | W | Concrete | Head gates | 60,000 | 0.95 | 13.8 | Auto | BG | CGE | |
| 1954 | 1,260,000 | 4 | 57-58 | 1,680,000 | 16 | 105,000 | Francis | 150 | 305-289 | 292 | DEC | W | Plate steel | Head gates | 80,500 | 0.95 | 13.8 | Auto | AG | CGE | 70 |
| | | | | | | | | | | | | | | | 80,500 | 0.95 | 13.8 | Auto | BG | CWC | |
| 1957 | 270,000 | ... | ..... | 270,000 | 6 | 45,000 | Derlaz | 92.3 | 87-40 | 83 | EEC | W | Plate steel | Head gates | 31,000 | 0.95 | 13.8 | Auto | BG | CWC | 71 |
| | | | | | | Run in reverse as 55,000-hp 4600-cfs 75-ft head pumps. Head ranges 59 to 80 ft | | | | | | | | | | | | | | | |
| 1960 | 210,000 | 5 | 1960 | 420,000 | 5 | 42,000 | Propeller | 102.9 | 47-58 | 50 | DEC | W | Concrete | Head gates | 37,500 | 0.90 | 13.8 | Both | BG | CGE | 72 |
| 1960 | 9,200 | 1 | 1960 | 18,000 | 2 | 9,200 | Kaplan | 225 | ..... | 63 | CAC | W | Welded pl st | Head gates | 7,000 | 1.0 | 6.9 | Both | BG | CGE | 73 |
| 1961 | 12,000 | 1 | 1961 | 24,000 | 1 | 12,000 | Francis | 257 | 125.5 | 122 | KMW | W | Welded pl st | ..... | 11,250 | 0.80 | 13.8 | ..... | BG | WE | 74 |
| 1960 | 8,000 | 1 | 1960 | 16,000 | 1 | 8,000 | Francis | 225 | 87 | 85 | KMW | W | Welded pl st | ..... | 7,500 | 0.80 | 6.9 | ..... | BG | WE | 75 |
| 1960 | 5,600 | 1 | 1960 | 11,200 | 1 | 5,600 | ..... | 600 | 950 | 950 | GGG | .... | Welded pl st | Butterfly | 5,200 | 0.80 | 2.4/4.2 | Manual | HS | CGE | 76 |
| 1962 | 276,000 | 6 | 1962 | 368,000 | 6 | 46,000 | Francis | 120 | 97-114 | 105 | AJ | ASEA | Welded pl st | Head gates | 37,500 | 0.90 | 14.4 | ..... | BG | EE | 77 |
| 1953 | 10,000 | 1 | 1960 | 20,000 | 3 | 10,000 | Kaplan | 150 | 34 | 40 | KMW | W | Concrete | Head gates | 12,000 | 0.85 | 6.9 | Both | BG | CWC | 78 |

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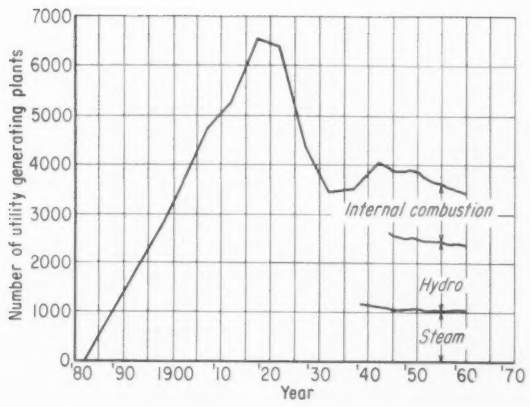
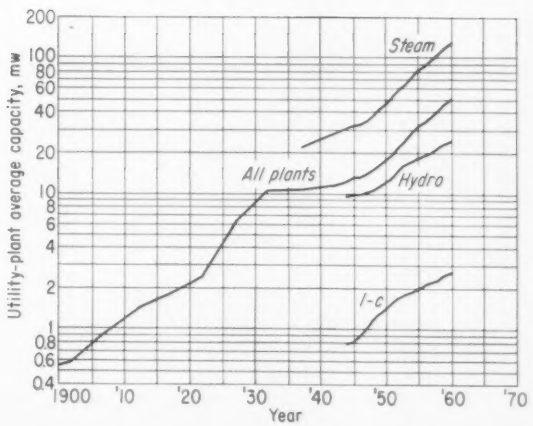
KMW - KMW of Sweden
MS - S Morgan Smith Co
NN - Newport News Shipbuilding & Drydock Co
PB - Pelton Div, Baldwin-Lima-Hamilton Corp
W - Woodward Governor Co
WE - Westinghouse Electric Corp
5 Thrust bearing
AG - above generator rotor
BG - below generator rotor
HS - horizontal shaft unit
6 two runners for each turbine
7 listed 1958 survey, revised data
8 fixed wheel
9 diversion dam above Smith River
10 all removed in redevelopment
11 subject to receiving FPC license
12 power dam
13 power dam, reservoir embankment is 34,625 ft
14 lower dam
15 upper dam
16 kilowatts

# and better use of materials




**NUMBER OF GENERATING PLANTS** on U.S. utility systems grew to peak of 6542 in 1917, reflecting growth of small local systems. Improvement in transmission technology then led to interconnection, eliminating less-efficient plants, and this trend is still going strong

**AVERAGE CAPACITY OF UTILITY PLANTS** grows steadily over the years in the drive for more economical generation. Compare these with table of 20 largest hydro and steam plants on next page. Development of supersize units may tend to accelerate steam-plant curve

## Twenty largest hydroelectric plants in the U.S.

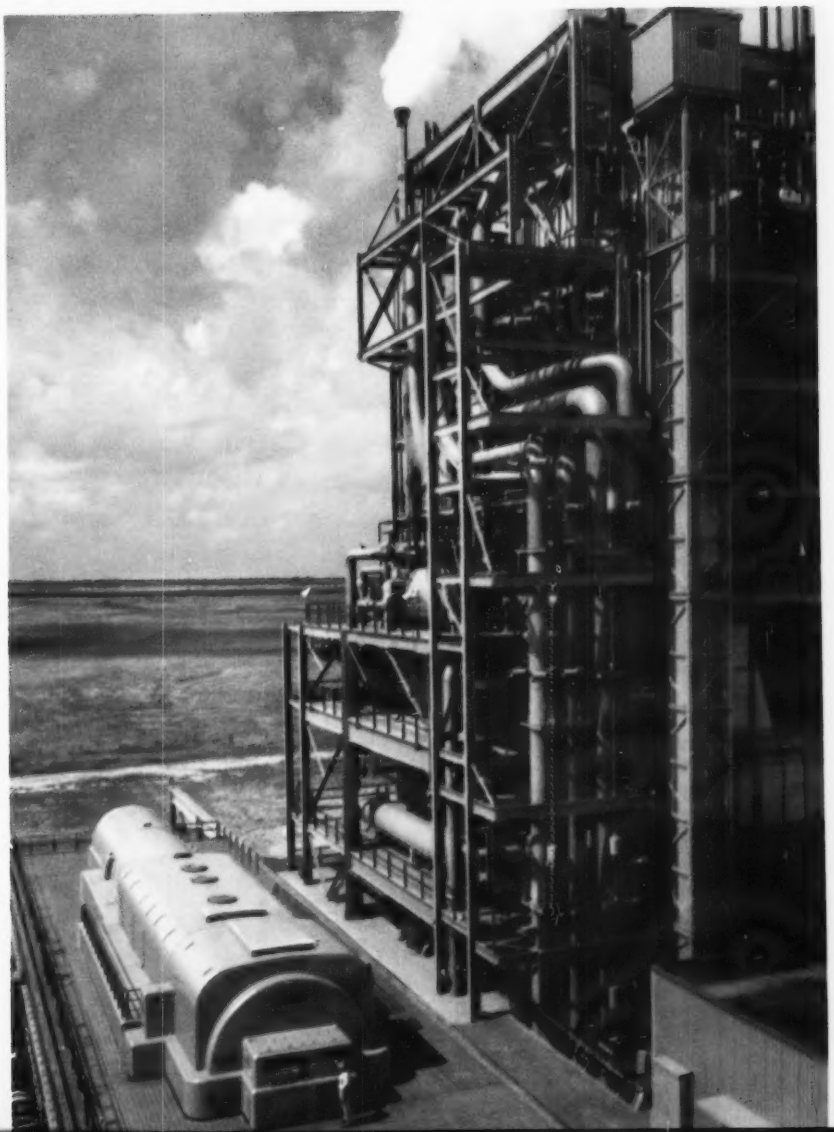
| | Capacity, mw | No. of units | Plant | Head, ft. | River | System | State | Date |
|---|---|---|---|---|---|---|---|---|
| 1. | 1974 | 21 | Grand Coulee | 330 | Columbia | Bureau of Reclamation | Wash. | 1941 |
| 2. | 1950 | 13 | Robert Moses Niagara | 300 | Niagara | Power Authority of State of N. Y. | N. Y. | 1961 |
| 3. | 1824 | 32 | Robert Moses — Robert H. Saunders | 81 | St. Lawrence | Power Authority of State of N. Y. | N. Y., Canada | 1959 |
| 4. | 1345 | 19 | Hoover | 480 | Colorado | Bureau of Reclamation | Ariz., Nev. | 1961 |
| 5. | 1029 | 16 | Chief Joseph | 165 | Columbia | U. S. Army Corps of Engineers | Wash. | 1958 |
| 6. | 986 | 16 | McNary Lock and Dam | 80 | Columbia | U. S. Army Corps of Engineers | Ore. | 1957 |
| 7. | 900 | 8 | Glen Canyon | 450 | Colorado | Bureau of Reclamation | Ariz. | UC |
| 8. | 831 | 10 | Wanapum | 75 | Columbia | Pub. Util. Dist. of Grant County | Wash. | 1963 |
| 9. | 788 | 10 | Priest Rapids | 78 | Columbia | Pub. Util. Dist. of Grant County | Wash. | 1961 |
| 10. | 657 | 12 | The Dalles | 81 | Columbia | U. S. Army Corps of Engineers | Ore. | 1960 |
| 11. | 522 | 11 | Bonneville | 50 | Columbia | U. S. Army Corps of Engineers | Ore. | 1943 |
| 12. | 477 | 11 | Conowingo | 89 | Susquehanna | The Susquehanna Power Company | Md. | 1965 |
| 13. | 436 | 18 | Wilson Dam | 92 | Tennessee | Tennessee Valley Authority | Ala. | 1950 |
| 14. | 379 | 7 | Shasta | 480 | Sacramento | Bureau of Reclamation | Calif. | 1949 |
| 15. | 360 | 5 | Brownlee | 274 | Snake | Idaho Power Company | Wash. | 1959 |
| 16. | 360 | 4 | Ross | 395 | Skagit | City of Seattle | Wash. | 1956 |
| 17. | 282 | 9 | Clark Hill Reservoir | 136 | Savannah | U. S. Army Corps of Engineers | S.C., Ga. | 1954 |
| 18. | 252 | 3 | Noxon Rapids | 152 | Clark Fork | Washington Water Power Company | Mont. | 1959 |
| 19. | 240 | 12 | Lewiston Pump-Generating | 75 | Niagara | Power Authority of State of N. Y. | N. Y. | 1961 |
| 20. | 230 | 7 | Safe Harbor | 55 | Susquehanna | Safe Harbor Water Power Corp. | Pa. | 1940 |

## Twenty largest steam-electric plants in the U.S.

| | Capacity, mw | No. of units | Plant | Press — temp. | System | State | Date |
|---|---|---|---|---|---|---|---|
| 1. | 1459 | 5 | Astoria | 2000-1050/1000 | Consolidated Edison Co. of N. Y. | N. Y. | 1962 |
| 2. | 1440 | 9 | Kingston | 1800-1050/1050 | Tennessee Valley Authority | Tenn. | 1955 |
| 3. | 1350 | 10 | Shawnee | 1800-1000/1000 | Tennessee Valley Authority | Ky. | 1956 |
| 4. | 1310 | 6 | Pittsburg | 2400-1050/1000 | Pacific Gas & Electric Co. | Calif. | 1961 |
| 5. | 1304 | 6 | Clifty Creek | 2000-1050/1000 | Indiana-Kentucky Electric Corp. | Ind. | 1957 |
| 6. | 1300 | 2 | Paradise | 2400-1050/1000 | Tennessee Valley Authority | Ky. | 1962 |
| 7. | 1275 | 6 | St. Clair | 2400-1050/1000 | Detroit Edison Co. | Mich. | 1961 |
| 8. | 1275 | 10 | New Johnsonville | 2000-1050/1000 | Tennessee Valley Authority | Tenn. | 1959 |
| 9. | 1250 | 7 | Widows Creek | 2400-1000/1000 | Tennessee Valley Authority | Ala. | 1960 |
| 10. | 1200 | 5 | Colbert | 2400-1050/1000 | Tennessee Valley Authority | Ala. | 1962 |
| 11. | 1175 | 5 | Allen | 2400-1050/1000 | Duke Power Co. | N. C. | 1961 |
| 12. | 1107 | 4 | Will County | 2400-1000/1000 | Commonwealth Edison Co. | Ill. | 1962 |
| 13. | 1090 | 11 | C. R. Huntley | 2400-1050/1000 | Niagara-Mohawk Power Corp. | N. Y. | 1958 |
| 14. | 1086 | 5 | Kyger Creek | 2000-1050/1000 | Ohio Valley Electric Corp. | Ohio | 1957 |
| 15. | 1056 | 8 | Waukegan | 2400-1000/1000 | Commonwealth Edison Co. | Ill. | 1962 |
| 16. | 1050 | 4 | Gallatin | 2000-1050/1050 | Tennessee Valley Authority | Tenn. | 1959 |
| 17. | 1050 | 5 | Philip Sporn | 3500-1050/1050 | Ohio Power Co. | W. Va. | 1959 |
| 18. | 1041 | 6 | Joppa | 1800-1050/1000 | Electric Energy Incorporated | Ill. | 1955 |
| 19. | 1000 | 4 | Segco No. 1 | 2000-1000/1000 | Southern Electric Generating Co. | Ala. | 1962 |
| 20. | 1000 | 4 | Alamitos | 2400-1050/1000 | Southern California Edison Co. | Calif. | 1962 |

NEW

# INSTALLATION TECHNIQUES MAKE ALL OTHERS OBSOLETE



ALLIS-CHALMERS

A-1492

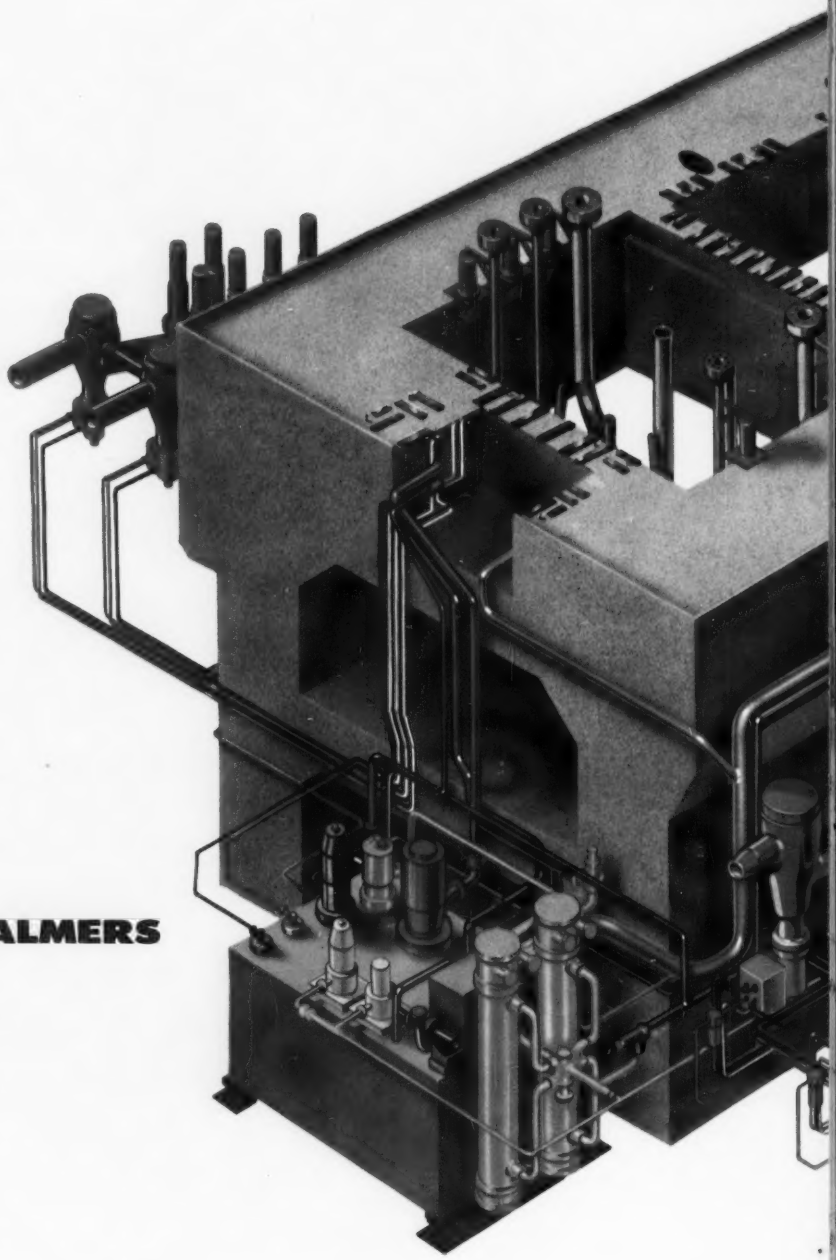
# Pre-installed piping systems and precision optical tooling cut man-hour expenditures as much as 34 percent

Exclusive A-C tools and techniques reduce turbine-generator installation costs — permit faster, ultra-accurate unit assembly — establish new power industry standards.

For example, a 220-mw tandem triple-flow unit (see bar chart) was recently installed in 25,000 man-hours with new A-C techniques — against 38,000 man-hours required with other methods. And this machine was placed on the line without a shutdown between first steam admission and attainment of maximum load — dramatic proof of the effectiveness of the advanced Allis-Chalmers methods. Equivalent results, unmatched in the industry, are being recorded with other large A-C units!

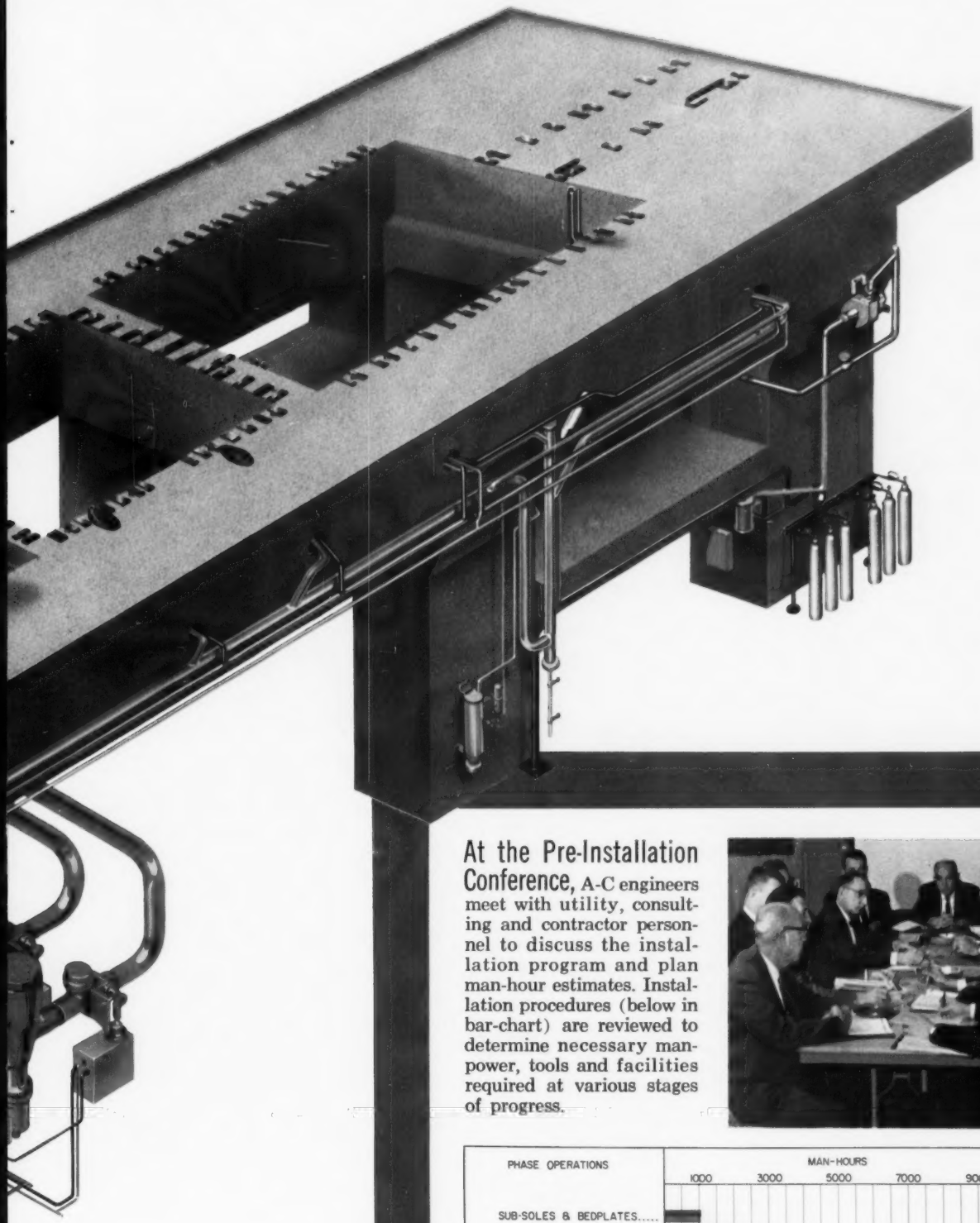
Factory-field coordination, based on modern turbine-generator assembly and testing facilities, translates components from test pit to foundation with absolute precision and man-hour reduction.

Advances such as these stem from Allis-Chalmers vast experience and forward-thinking engineering. They help electric utilities meet the economic and scientific challenges of tomorrow.

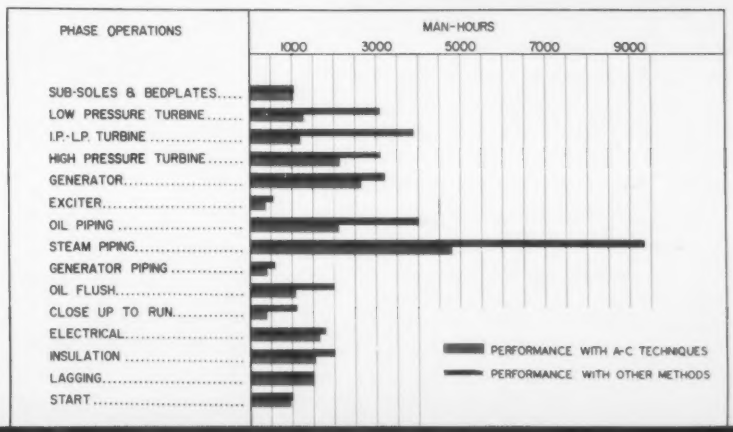


ALLIS-CHALMERS

**Pre-Installation of All Below-Floor Pipe and Equipment** is completed prior to placing of main unit components on foundation plates. This technique saves thousands of man-hours — assures highest degree of cleanliness and quality for piping and closure welds. Complete oil tank assembly and piping, steam chest, reheat valves and piping, generator coolant and scavenging piping systems are installed with better control . . . also, less interference because fewer men are present; the work area more accessible.

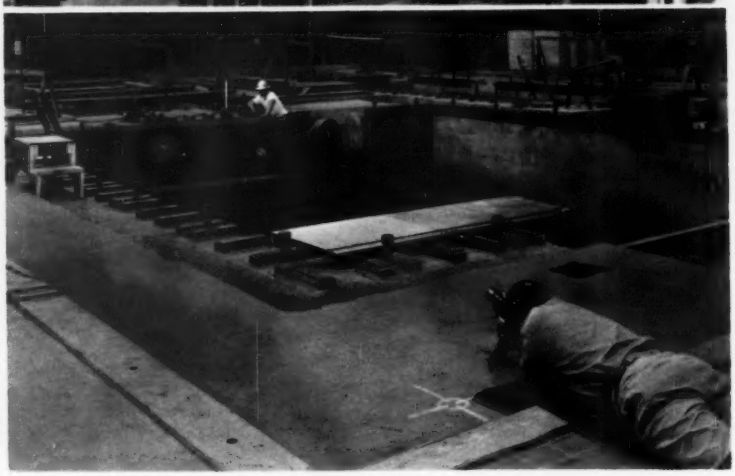


**At the Pre-Installation Conference,** A-C engineers meet with utility, consulting and contractor personnel to discuss the installation program and plan man-hour estimates. Installation procedures (below in bar-chart) are reviewed to determine necessary manpower, tools and facilities required at various stages of progress.



# PROCEDURES COORDINATED BY UNIFIED SUPERVISION

minimize installation time . . . assure ultra-accuracy . . . simultaneously!



**Installation Responsibility Under One Superintendent** unifies job supervision — uniquely covers existing A-C equipment at the power station as well as new turbine-generator and additional A-C products. Central responsibility assures close control of installation procedures — permits prompt job-site decisions.

**Special Centerline Telescope** permits quick alignment of major turbine components. During manufacture this precision instrument determines final relative position for each pedestal bearing bore. At the job site, the telescope re-establishes this centerline for accurate turbine assembly with all clearances as determined at the factory. Field measurement of internal clearances is eliminated and installation of components, including those shipped with spindles in position, is accomplished faster and more accurately.

☆ ☆ ☆

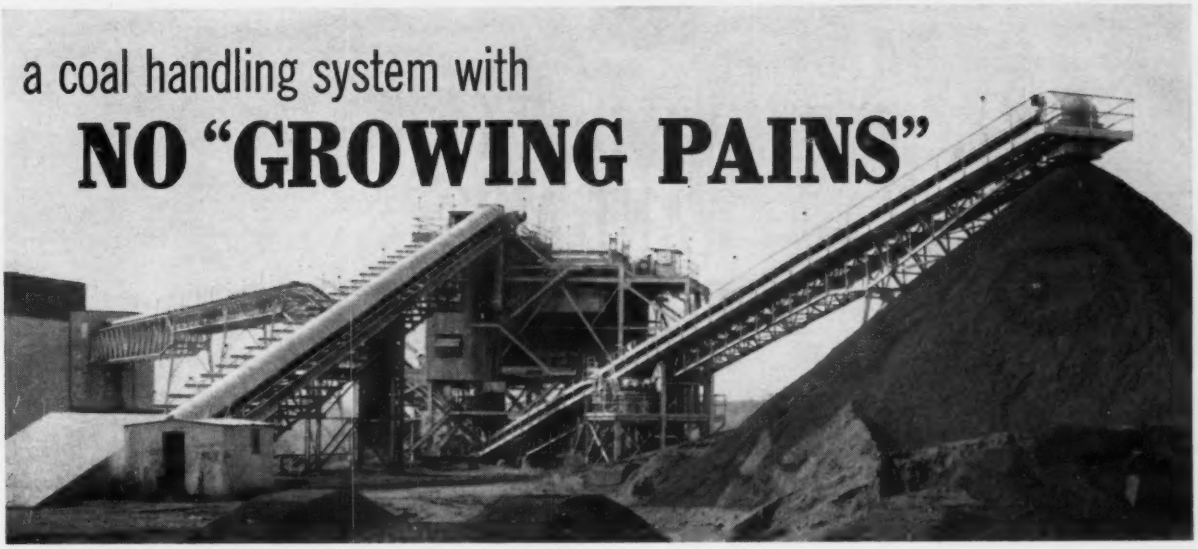
***For Bulletin 03B9997,*** *which gives you further information about Allis-Chalmers advanced installation techniques, ask your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.*

**With Precision Optical Leveling Equipment,** field installation of Allis-Chalmers turbine-generator units is little more than a reassembly operation. Savings to you . . . over 8,000 man-hours for a tandem triple-flow machine; similar reductions for other types and ratings. This special tooling permits simultaneous establishment of horizontal reference planes on the test pit (top) and on the foundation (bottom). All factory-recorded clearance and reference data plus assembly shim packs are translated from level plane to level plane. *Result: precise unit alignment and assembly with no time-consuming "cut and try" operations or delaying field adjustments.*

**ALLIS-CHALMERS** PACING POWER PROGRESS

a coal handling system with

# NO "GROWING PAINS"



**DICKERSON GENERATING STATION** of Potomac Electric Power Company was engineered jointly by PEPCo and Stone & Webster. It has two coal-fired steam generators, each rated 185,000 kw. The expandable Link-Belt coal handling system currently handles 750 tph.

**UNLOADING IS FAST AND EFFICIENT** with this Link-Belt rotary car dumper. It can empty a 90-ton capacity car in just 60 seconds, exclusive of spotting and removal time. Integral electronic scale weighs cars full and empty to determine load.

**COAL RIDES LINK-BELT CONVEYORS** from coal cars to power plant bunkers. First stop is the crusher house (center). From here, the minus 1½" coal is carried directly to bunkers or is directed to a Link-Belt stationary boom conveyor for outdoor storage.

**DISTRIBUTION TO BOILER BUNKERS** is done by a Link-Belt motor-propelled traveling tripper. The tripper operates on T-rail tracks and can be moved back and forth automatically over any one of the bunkers. The control panel is affixed to the tripper itself.

## EXPANDABLE Link-Belt system keeps pace with coal handling needs of PEPCo's rapidly growing Dickerson Station

Dickerson Station of Potomac Electric Power Co. went "on line" in 1959, added a 185,000 kw unit in 1960 and will boost capacity again in 1962. A key economy factor in this well-planned expansion program is the plant's Link-Belt coal handling system. With simple, low-cost modifications, the system can be expanded as required. In fact, provisions have been made to *double* the present 750-tph capacity.

This plant is just one example of how Link-Belt coal handling experience and equipment can be put to work for you. *Whatever* your problem, you can count on Link-Belt for a low-cost solution. We will work with your engineers and consultants from planning through erection of your system . . . or will assume complete responsibility for the entire installation. For details, contact your nearest Link-Belt office. Ask for Book 2410.

**LINK-BELT**

**COAL HANDLING EQUIPMENT**

**LINK-BELT COMPANY:** Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Warehouses and District Sales Offices in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs; Switzerland, Geneva. Representatives Throughout the World. 15,609

◀ circle 855 on Reader Service card, p 197

For more facts circle 856 on Reader Service card, p 197

# WE DON'T WANT ANY FLOATERS FOR THIS JOB!

Where it's important to maintain accurate liquid level control, it's risky to bank on a float or displacement type control when you can get one that's stable—never thrown off course by waves or surface turbulence—one that's designed simply and huskily built for year after year dependability.

The floatless pilot is Leslie-LevelMatic.® It works by precise sensing of any variations in differential pressure. Set a single-knob-adjustable proportional band to the exact response your system requires. The level set point is just as easy to set—independently—at will.

It's likely you'll pay much less for Leslie-LevelMatic control, too. There are no expensive float cages to buy and install. Installation involves only one, or at the most two, half-inch connections to the tank. And Levelmatic's inherent stability makes the optional reset feature more the exception than the rule.

Expect *low* maintenance costs—there are no wearing parts to cause breakdowns. Write today for illustrated Bulletin 583 presenting full details.

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Obviously some are more efficient than others. But often it takes a real expert in materials handling to know which of two or three methods is *most* efficient.

Because of its multiplant operations from coast to coast, Morton Salt Company has gained wide experience in all phases of salt handling. Today Morton maintains a department whose sole function is to advise on salt handling problems. There is no cost or obligation whatsoever for this service.

Just fill out and mail the coupon at right, and you will be contacted soon! Do it now—it may mean considerable savings plus increased efficiency for you!

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THE ONLY NATION-WIDE SALT COMPANY
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For more facts circle 858 on Reader Service card, p. 197

ONE OF A SERIES OF CHATS ABOUT THE CONSERVATION AND CONTROL OF HEAT

# SARCO TOPICS

## WHY THE BIG STRAIN?

It's tough to keep gases and liquids "clean" as they run through a pipe. They drag impurities along, which can make even plain water a trouble maker, let alone more sophisticated fluids. That's because water, as a liquid or steam, is intimately involved with vital equipment like steam traps, temperature regulators, or tools. Meters, burners, nozzles, and pumps, too.

By this time you must realize we're going to talk strainers, don't you? A good, stout subject, of interest to all who feel production belongs up and costs belong down. Sarco makes strainers for water and condensate, steam, oil, air, gas and other piped fluids . . . dozens of different sizes and types and ratings of strainers to match every application need. Even our line of plain and simple strainers is built for super service. These are pipeline strainers, types AT, BT, and CT, which are designed for 250, 250 and 600 psi non shock, respectively, and 475°, 450° and 750°F. temperature ratings. Standard screens are heavy-gauge, perforated brass or stainless steel. Sarco specializes in screens that can withstand abnormal pressure differentials created by accumulated sediment.

Next, Sarco's flanged strainers, type D. These come in larger sizes, right up to 12″, and are available in standard or extra heavy types.

And finally, *Sarco scraper strainers*, manual or motorized. These are the really eye-popping models, and if you can't use one yourself — well — you'll just have to get your kicks elsewhere.

Examples? Take Inland Steel Company at East Chicago, which gets water from Lake Michigan to cool its large air conditioner condensers. The water used to pass through traveling screens, but still contained fine sand. Clogging!

Heat under collars! Frequent cleaning required! Sometimes practically no air conditioning on hot days. (Isn't that always the way?)

The Inland Steel people installed Sarco Rotary Scraper Strainers, Type VRS, which incorporate a hand-operated helical scraper knife within the cylindrical strainer screen. A few turns of the crank at regular intervals, and the sand is scraped off the screen, blown clear, and discharged at pressure through a manual valve to waste. Dismantle the strainer? Shut down the unit? Not *this* strainer!

Now, as long as we've come this far, it's only a hop and a skip to the Firestone Tire and Rubber Co. in Akron, Ohio, who also use water in tremendous quantities. They circulate it through tire presses and a cooling tower, and there's no nonsense about it. It *has* to be clean or damage to equipment could be downright catastrophic. When the plant

modernized and enlarged, Firestone replaced their 4″ Sarco hand-operated scraper strainer, type VRS, with a larger Sarco 8″ model. And while they were about it, they got the motor-operated type, for continuous cleaning.

When we say that companies like these want the insurance of a Sarco strainer, it sounds like advertisingese, but sometimes there just isn't any other way to put it. Sarco strainers *are* insurance at low cost on the operation of your high cost equipment. So when we ask if you have lumps in your pumps, or worries over your slurries, we're *serious*. We've heard everything in the straining line, so why not write us for literature and answers to those special problems you have.

## A T-44 IS THE BEST POLICY

Sorry, but we can't leave the subject of insurance without bringing to your attention one of the best little insurance policies any company requiring cooling control could invest in. It's the *self-powered* Sarco T-44 Automatic Cooling Control. No compressed air or electricity is needed, but its advantages are best described in terms of three different plants of just one Sarco customer — Revere Copper and Brass, Inc.

Revere-Baltimore, Md., has cut water use 40 to 50% with T-44's. But in addition to former water waste, Revere had even more problems: possible wet air from uncontrolled cooling of compressor aftercoolers, plus sweating compressor cylinders; variations in viscosity of hydraulic oil and bearing oil; gas generator water waste; unreliability of manual shut-off of water supply when machines were down.

If your ears perk up in sympathy at mention of any of these problems, the results of Revere's cooling control program should bring you to full attention. One large compressor that had gulped 2400 gallons per hour now takes only 420 gallon sips. In addition all the problems itemized above were solved. T-44's are now used on their air compressors, gas generators, and hydraulic oil systems. At Revere-Riverside, Cal., water savings of 50% were experienced, and at Revere-Rome, N.Y., substantial savings were made too.

But after all, wasting water is only one way of wasting money, so let's go on to another matter of interest: the evils of manual control. When cooling water is controlled by hand the temptation to leave the valve nearly wide open is almost overpowering, in order to play it safe if the load varies. Result: overcooling, of course. And varying the flow runs the risk of undercooling. In either case, lowered process efficiency. Answer: The automatic Sarco T-44, which can't be tempted, is meticulously honest, unsentimental, and plain inhumanly practical when it comes to cooling control. You really ought to write for literature. T-44 is your best policy.

## SPARE PARTS INSURANCE

As long as we're near the end, and still on this subject of insurance, may we graciously leave you with this valuable tip? No matter how closely a steam trap approaches perfection, some gremlin may cause it to act up. It's conceivable. So, keep on hand a parts list and spares of key parts for your steam traps and other system components. Parts are small and worth their weight in gold when you need them. A Sarco field engineer will make up a suggested list for you, if you tell us what components make up your system.

Might as well even keep a disc or two on hand for your Sarco Thermo-Dynamic Steam Traps, Type TD-50, even though they're so trouble-free our salesmen keep complaining about the lack of replacement parts business. We'll be glad to tell you about this unique steam trap in case you still don't know how miraculously simple and effective it is.

*Pardon our monopolizing the conversation in this series of paid communiques, but we're trying our best to interest you in certain subjects that concern us both — to the point where you'll communicate.*

5903

SARCO

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PLANT: BETHLEHEM, PA.

STEAM TRAPS • TEMPERATURE CONTROLLERS
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For more facts circle 859 on Reader Service card, p 197

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# versatility...

## in pumps for POWER GENERATING PLANTS

What ever your steam generation pumping needs there is a Pacific Pump to meet your exact requirements.

***BOILER FEED SERVICE*** In the high pressure-high capacity range—conventional and high speed barrel type units. In the moderate capacity and pressure range—heavy duty horizontally-split case multi-stage pumps and unitized Steam Turbopumps.

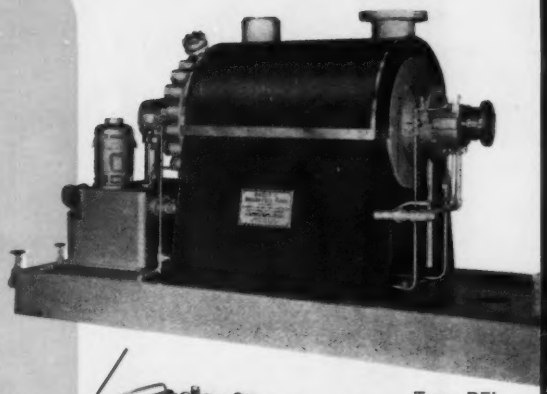
***CONDENSATE AND HEATER DRAIN SERVICE*** Multi-Stage vertical pumps sized to meet all steam plant design requirements economically.

***BOOSTER SERVICE*** Multi-stage vertical and horizontal pumps in a size range providing ample flexibility and capacity.

***GENERAL SERVICE*** A wide selection of single and two-stage horizontal pumps for transporting small or large quantities of fluids.

Investigate the full line of Pacific centrifugal pumps for efficient, economical pumping in your steam generating plant.

***Write for Pacific A to Z Bulletin 176***



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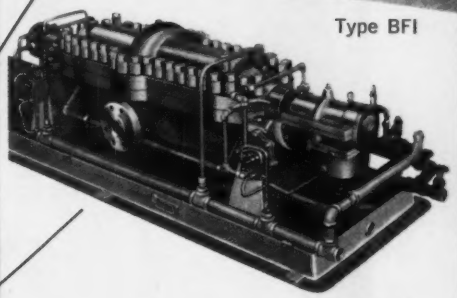

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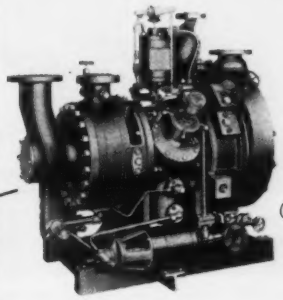

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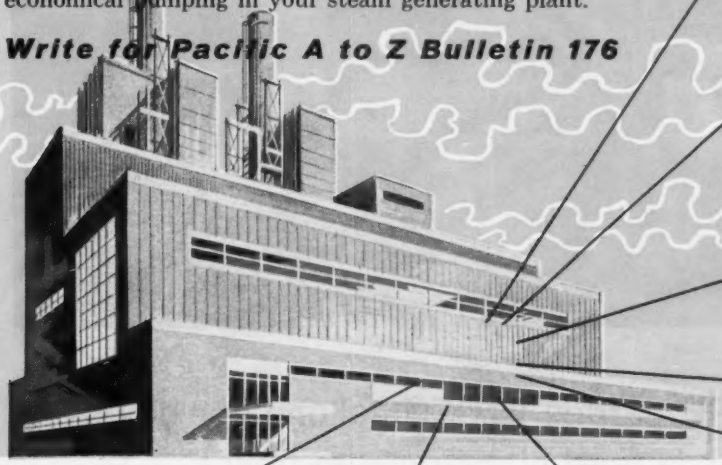
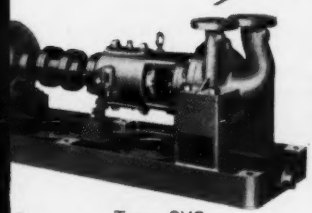
(Steam Turbopump)





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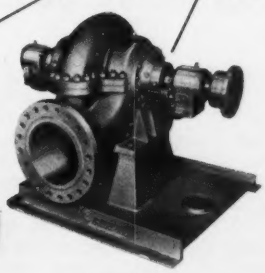

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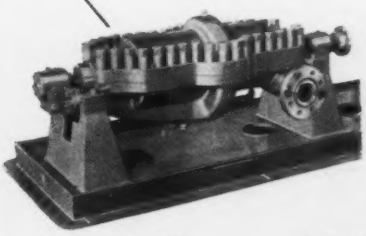

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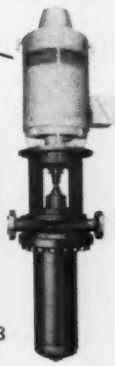

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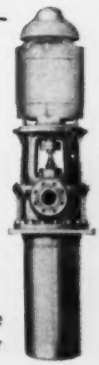

Type WY

PACIFIC

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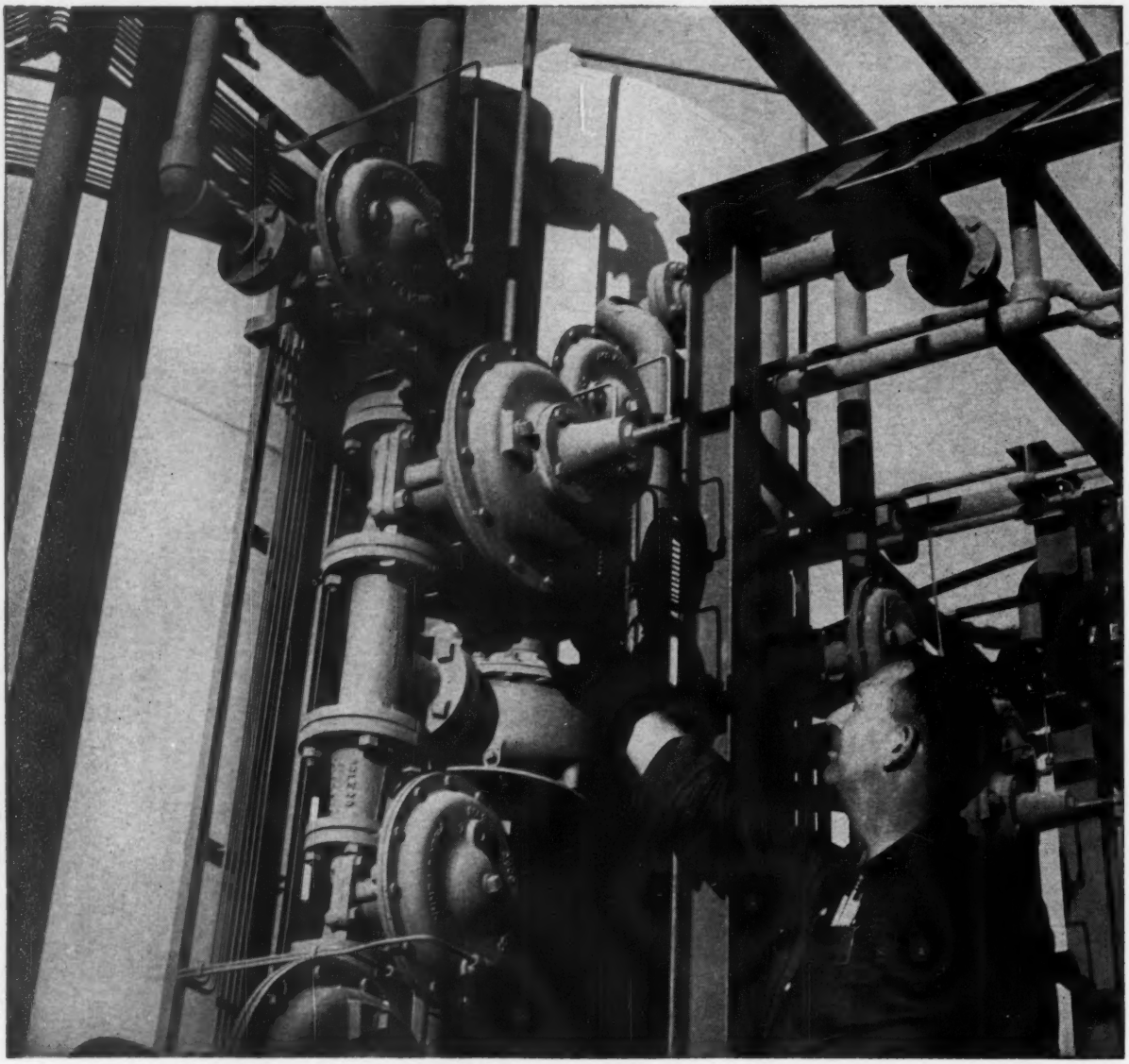
*Inc... A Division of Dresser Industries, Inc.*

**HUNTINGTON PARK, CALIFORNIA, U.S.A.**



California Electric Power Company's generating station, Yuma, Arizona

# **SARAN LINED PIPE** carries 10,000 gallons per day of "hungry" water to feed high-pressure boiler

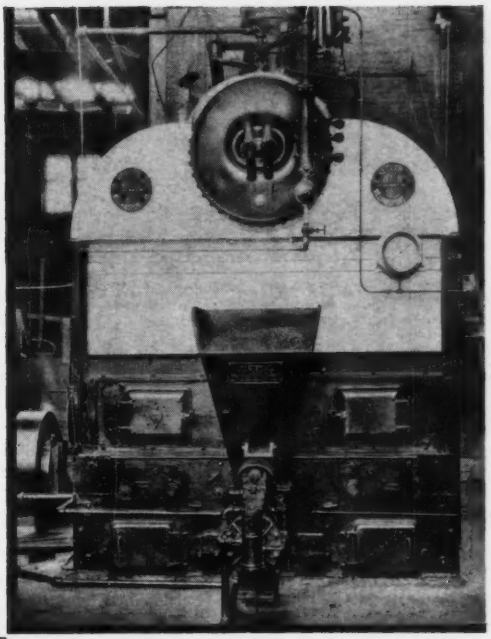
At California Electric Power Company's generating station above, a quarter-mile of Saran Lined Pipe feeds highly active deionized water to a high pressure boiler system. This "hungry" water attacks unprotected iron and steel pipe, corroding enough metal to put the boiler and steam turbine out of business and causing such damage to the piping that it must eventually be replaced.

Station Superintendent A. A. Lingo says, "We specified Saran Lined Pipe and valves for this application because, from experience, we knew we could depend on its corrosion resistance. Another important, though not primary, basis for our choice was the reasonable over-all cost of a Saran Lined Pipe installation."

This installation contains nearly 1200 feet of Saran Lined Pipe, 400 feet of it in a vital demineralizing unit. The remainder carries the deionized water to 300,000-gallon storage tanks, and from there to the steam generator. Saran Lined Pipe combines high corrosion resistance and high physical strength. It requires minimum external support on straight runs and little or no maintenance even after years of carrying highly reactive materials.

Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200° F. They can be cut, fitted and modified easily in the field without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 1569DW10.

**THE DOW CHEMICAL COMPANY** DOW Midland, Michigan



THE FIRST KEELER TYPE CP STEAM GENERATOR

Installed in 1936 at the Crystal Laundry in Frederick, Maryland

THE FIRST KEELER CP

# ...still delivering trouble-free service with minimum maintenance after 25 years of continuous operation

Here's what Crystal Laundry general manager A. C. Thomas has to say about the Keeler CP which serves his firm's requirements . . .

*"This boiler has been so entirely satisfactory that if it was necessary to replace it, we would buy another Keeler. It has been very dependable."*

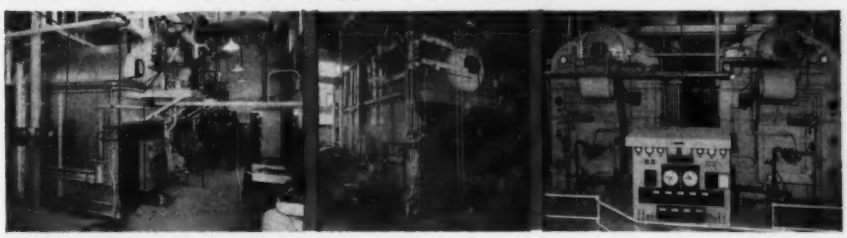
This Keeler CP Steam Generator *first* introduced furnace water wall design—*the first* boiler to offer large power plant reliability and economy in low-cost, factory assembled form. The CP design provides greater steam capacity per cubic foot of space occupied, greater furnace volume with less head room and more BTU's per square foot from radiant heat.

Other owners of 25-year old Keeler CP's report *"complete satisfaction on all points" . . . "no replacement or major maintenance" . . . "no failures despite long periods of over-rating operation" . . . "both units in service at full pressure" . . . "good dependable performance, producing far in excess of rating" . . . "well pleased with low operating and maintenance costs"!*

This type of steam generator economy and reliability is available in capacities up to 150,000 lb stm/hr—for all methods of firing, all types of fuel (and readily convertible). *Write or phone for full information . . .* insist upon Keeler quality to be sure of true economy and unmatched performance!

**recent CP installations**

A three-unit oil fired installation at an eastern high school; one of two stoker fired units at a midwestern college; and a two-unit gas fired installation at a tobacco processing plant.



*The Seal of Quality in Water Tube Steam Generators*

WRITE FOR FREE BULLETINS
No. F-14: Type CP Boilers
No. M-2A: Type CPM Package Boilers
No. DK-2: Type DK Package Boilers
No. MK-1: Type MK Boilers
No. MKL-1: Type MKL Boilers

KEELER WATER TUBE Boilers

— ESTABLISHED 1864 —

**E. KEELER COMPANY**
200-300 West St. • Williamsport, Penna.
— OFFICES IN PRINCIPAL CITIES —
*In Canada: Canadian Vickers, Ltd., Montreal, P. Q.*



For more facts circle 862 on Reader Service card, p 197

# FIRST PRE-PACKAGED

## electric storage water heater for commercial, industrial and institutional use.

The new P-KW is the first electric storage water heater to be offered as a standard package unit. It is shipped fully wired, insulated and factory tested. It requires only electrical and water connections to place in operation.

The new unit is equipped with immersion heater, control thermostat, magnetic contactors, circuit breaker, panel control box, ASME temperature and pressure relief valves, thermometer, pressure gauge, metal jacketed insulation, and integral support skids.

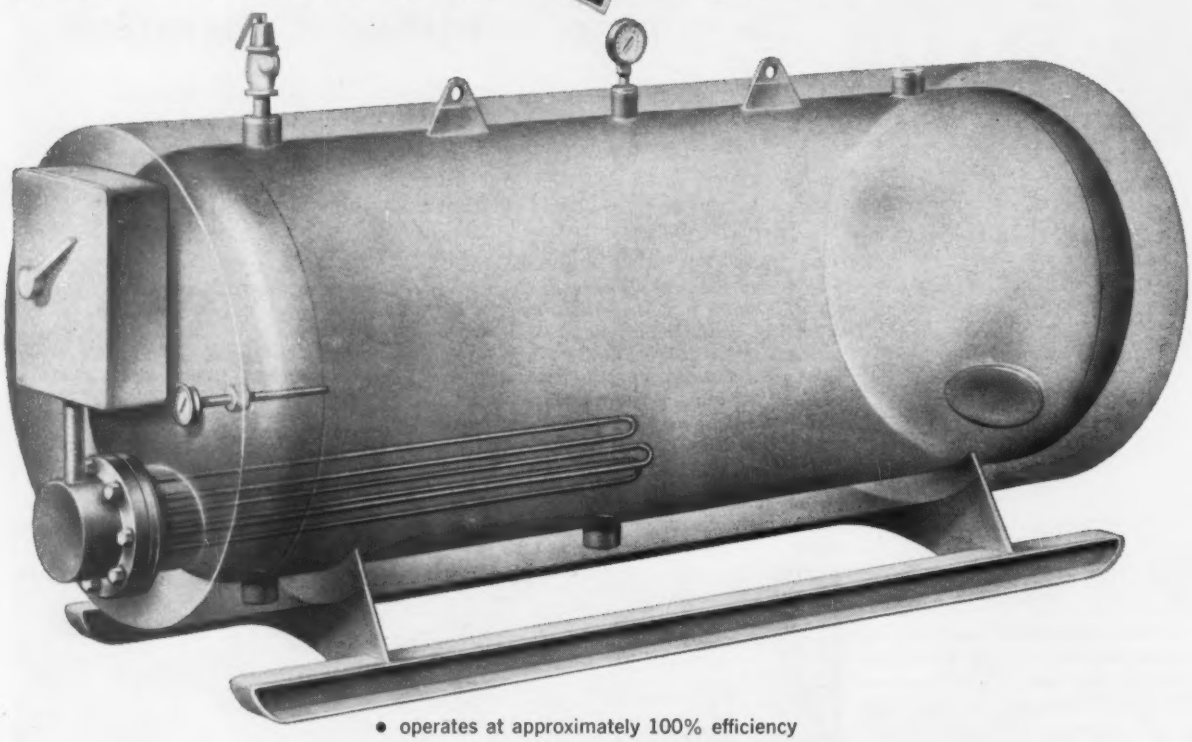
Made by P-K on a custom basis for many years, P-KW Electric Storage Water Heaters are designed and fabricated in accordance with the ASME Code and Federal, State and local regulations.

Components that comprise the electrical system, including wiring, meet the requirements of Nema standards and the National Electrical Code.

The immersion heating elements are operated approximately 10 per cent below their voltage capacity—assuring long, trouble-free service. The thermal conversion approximates 100 per cent efficiency.

Pre-packaged P-KW water heaters can be selected for three working pressures — 100, 125, and 150 psi.

WRITE FOR CATALOG NO. P-KW-1: contains diagrams, specifications, complete engineering and performance data. Address your request to: The Patterson-Kelley Co., Inc., 810 Morgan Avenue, East Stroudsburg, Pa.



- operates at approximately 100% efficiency
- storage capacities from 284 to 1,300 gallons
- recovery capacities from 41 to 410 gph
- horizontal or vertical design
- safe, silent, automatic

**Patterson Kelley**

For more facts circle 863 on Reader Service card, p 197

circle 864 on Reader Service card, p 197 ➤

# how much is an hour worth?

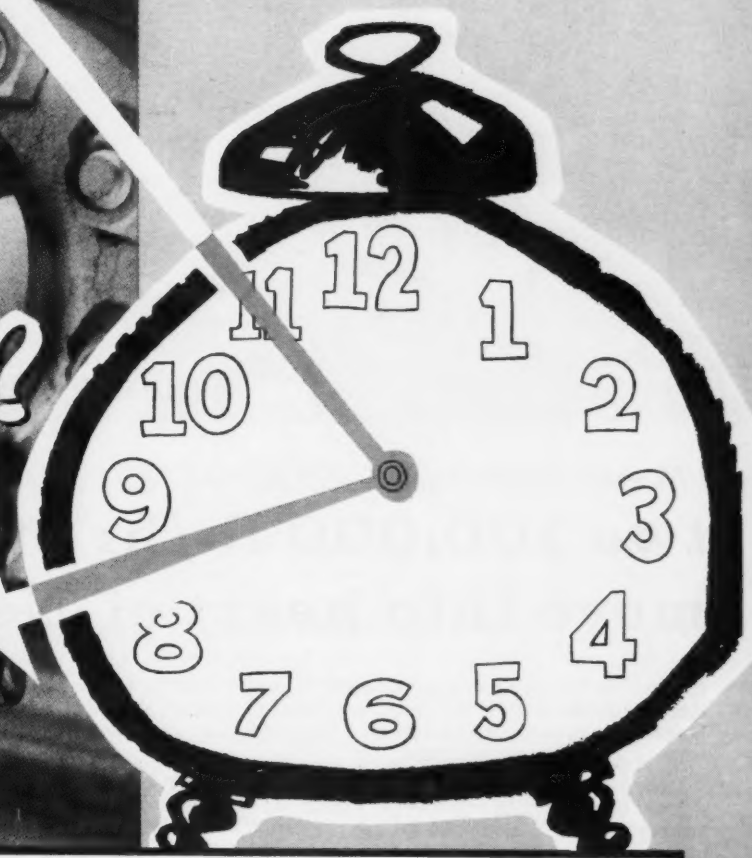
**BS&B Exclusive Clamp Ring Reduces Process Down Time**

Some control valves last for years; others need frequent servicing to change out the inner valve and other internals; or to clean out the flow line. When this happens, extra time for shut-down of a process becomes economically critical.

How much time will the clamp ring save? It varies, of course, but you might ask the man who has changed out the trim on a six or eight inch valve. The time saved will be in hours! The two studs on the clamp ring are in sharp contrast to the many studs necessary to contain a flanged closure.

Concentricity and vertical alignment of valve internals is enhanced by the angular seating surfaces of the clamp ring. Some buyers are using this valve based on this feature alone. And, why not? This valve costs no more. Its servicing advantages to the buyer is an added premium.

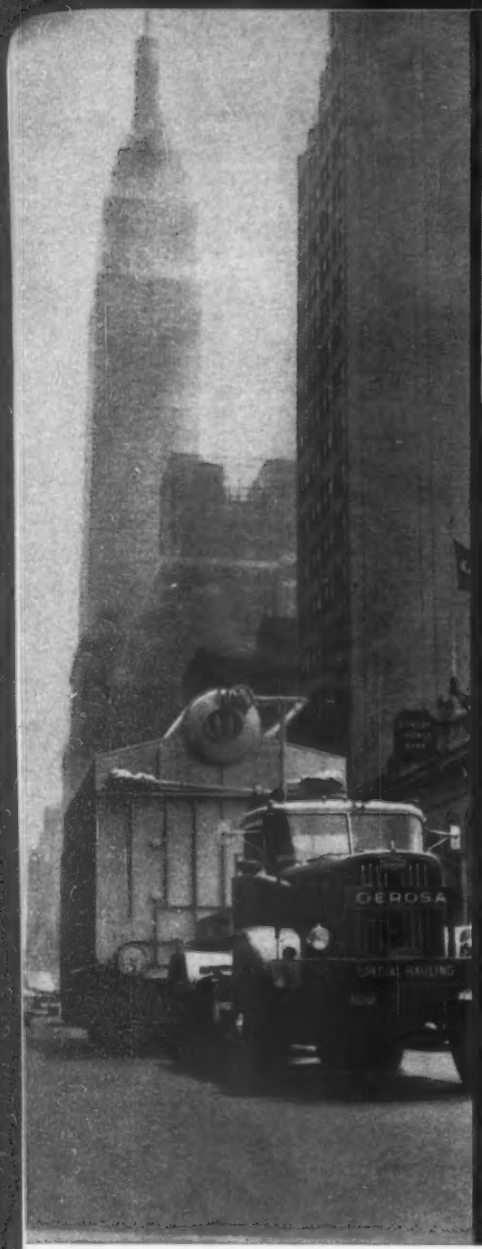
If servicing valves can create a problem for you, we suggest you contact your BS&B representative and ask about valves with clamp ring closures, or write: Black, Sivalls & Bryson, Inc., 7500 E. 12th Street, Kansas City, Missouri.

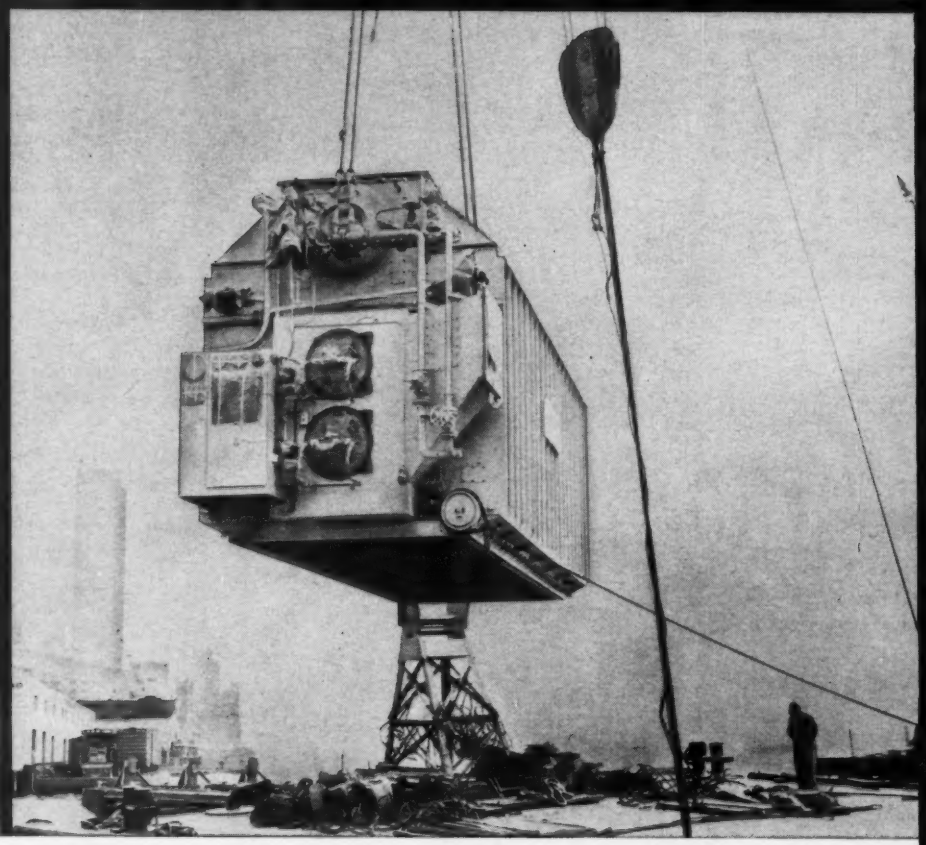



BS&B

**BLACK, SIVALLS & BRYSON**

TULSA • OKLAHOMA CITY • KANSAS CITY • EDMONTON • THE HAGUE





*VIA RAIL, BARGE AND TRUCK:*

# two 100,000 lb/hr steam generators move into heart of New York City

En route to Pennsylvania Station South Housing Project in Manhattan, this pair of Union Type MH Packaged Steam Generators demonstrates how steam requirements (in excess of 100,000 lbs./hr.) can be fulfilled without involving field assembly.

Placed by the contractor, Raisler Corporation, the two units were shipped complete with refractories, casing, MH Firing Units, and connecting duct work. Equipped for burning No. 6 oil, each of the MH's has a capacity of 100,000 lbs./hr. at 450 psi and 600° F.

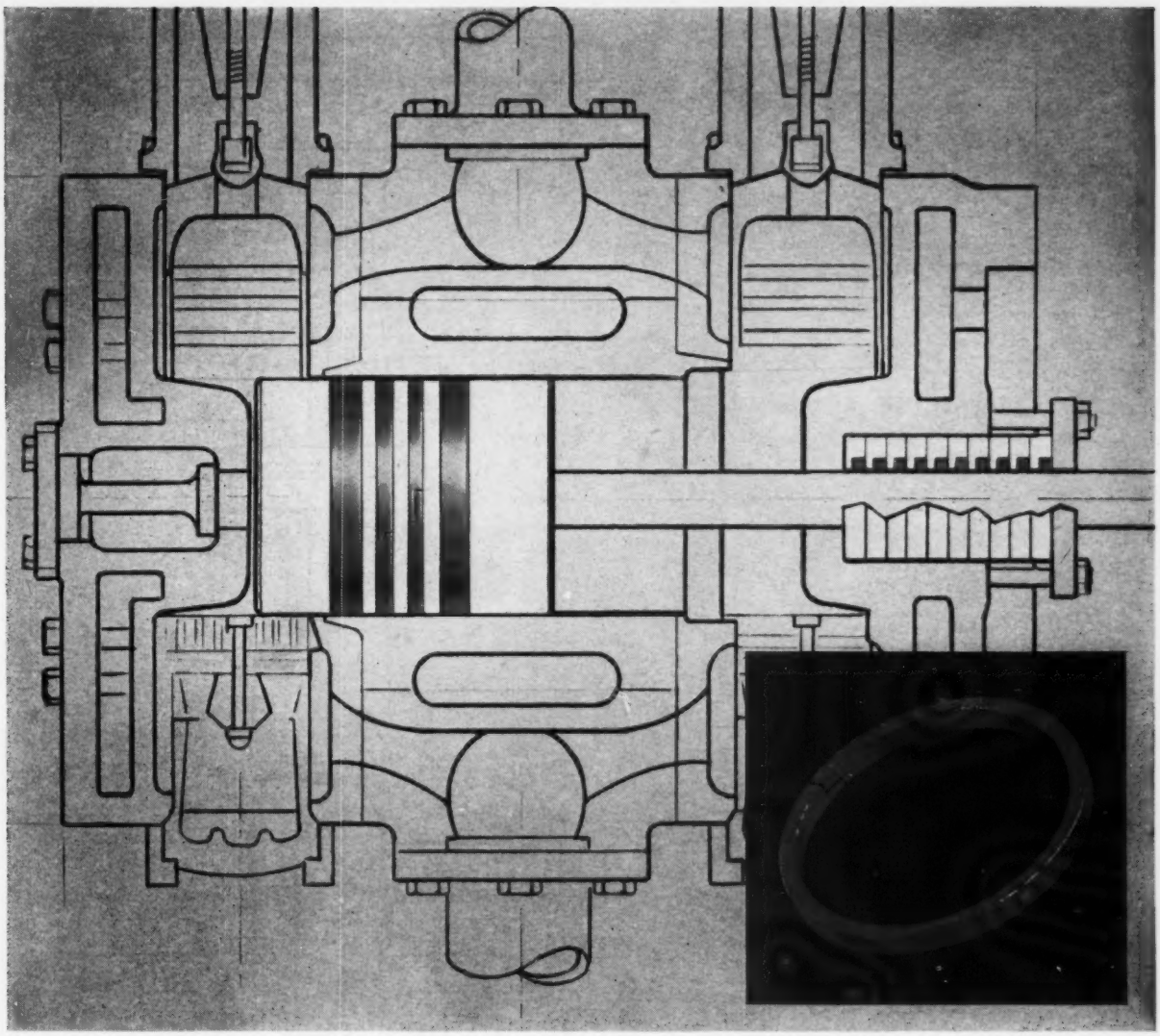
Shop assembled to standardized designs, Type MH Steam Generators and Firing Units can be supplied to handle diversified needs without costly special engineering. They can be arranged for oil or gas firing or both, with fully automatic, semi-automatic or manual control. The symmetrical, 3-drum MH design, with the top drum centered, makes it possible to ship larger units within existing rail clearances.

For detailed information, contact your local Riley Stoker Corporation or Union Iron Works office.

UNION

**UNION IRON WORKS**
**ERIE, PENNSYLVANIA**
**A DIVISION OF RILEY STOKER CORP.**

**For more facts circle 865 on Reader Service card, p 197**



# How piston rings of TEFLON® eliminated fire hazard and saved $4,500 per year

Oil contamination in an instrument air system caused serious problems in a large manufacturing plant. Oil plugging the lines not only led to heavy maintenance costs, but also created a dangerous fire hazard. Converting the eight instrument air compressors to piston rings of TEFLON solved the problems and saved the plant money.

The greatly reduced lubrication required with rings of TEFLON (no oil at all was added to the cylinder) eliminated the oil contamination and system plugging. In addition to cutting maintenance costs substantially, the rings of TEFLON lasted longer than previously used carbon rings, saving $3,000 per year in ring cost, and virtually eliminated cylinder wear, saving another $1,500 in cylinder refinishing.

Piston rings of TEFLON are your most logical and economical choice whenever reduced lubrication would be desirable . . . whenever problems of product contamination arise . . . whenever ring brittleness causes handling, installation, or operating difficulties. If you are buying a new compressor, specify rings and packings of TEFLON TFE resin. To convert your present equipment, check with your compressor manufacturer or qualified ring supplier for engineering and design assistance. For more information write to: E. I. du Pont de Nemours & Co. (Inc.), Dept. P-10, Room 2526, Wilmington 98, Delaware.

*In Canada:* Du Pont of Canada Limited, Box 660, Montreal, Quebec.

DU PONT
REG. U.S. PAT. OFF.

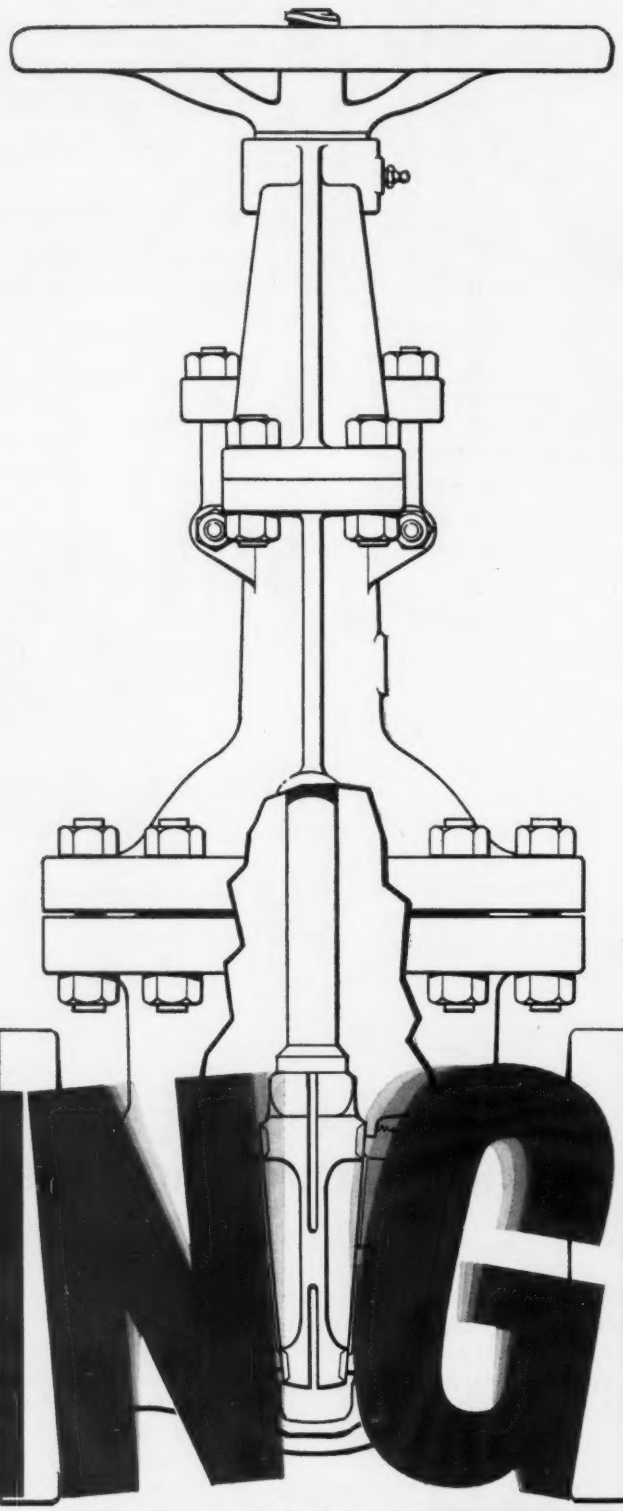
TEFLON®
FLUOROCARBON RESINS

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

*TEFLON is Du Pont's registered trademark for its family of fluorocarbon resins, including TFE (tetrafluoroethylene) resins and FEP (fluorinated ethylene propylene) resins.*



For more facts circle 866 on Reader Service card, p 197



# LIVING

**Walworth's last word in positive sealing! When valve bodies are tortured out of shape by line pressure, temperature or deflection—new Walworth living wedge Gate Valves still seal tight! It's because of Walworth's unique one-piece split disc gate that lives in the body...flexes and gives, to stay mated to the seat in spite of body distortion. Yet new Walworth living wedge Gate Valve operates at low torque, can't bind, jam or stick—and is economical, needing**

# WEDGE

minimum replacements. Get new Walworth living wedge Gate Valves in 150 and 300 pound ASA ratings, 2″ to 24″. See your Walworth distributor for details, or write to Walworth Company, 750 Third Avenue, New York 17, N. Y.

**WALWORTH**

the Walworth companies: Alloy Steel Products Co.—Conoflow Corporation—Grove Valve and Regulator Co.—M & H Valve and Fittings Co.—Southwest Fabricating & Welding Co., Inc.

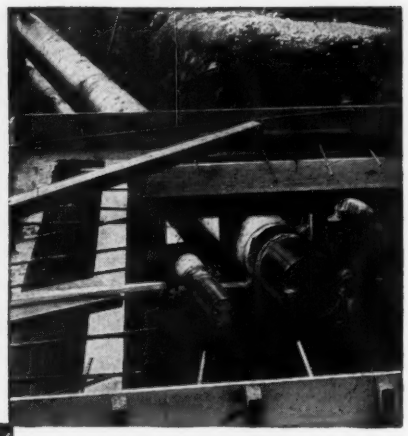



For more facts circle 867 on Reader Service card, p 197

*MR. ENGINEER:*

*LET'S FACE THE FACTS . . .*

# Can you be sure your underground piping system is watertight if you can't *AIR TEST* it?



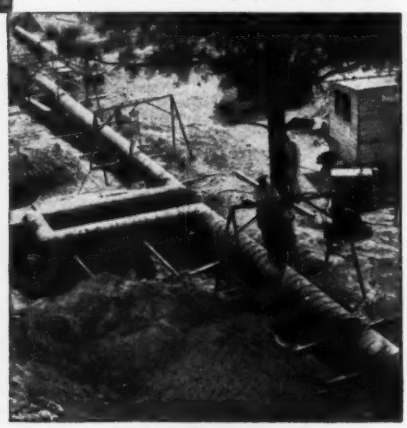
Test caps applied to unit ends for air testing full-welded conduit system.

During air test, conduit field welds are checked with soap solution.

***WITH***

# RIC-WIL

Tested and ready for lowering long lengths.



## *YOU can AIR TEST your system...*

**The RIC-WIL method of making full-welded field closures allows the installer to AIR TEST the system prior to completion and backfilling. This simple 15 lb. pressure test gives greater assurance of a tight, leak-proof system. It provides the finest practicable protection to the owner against an initial system failure ...and most important, the long range effects of water corrosion.**

**Ask a RIC-WIL field representative for detailed information regarding Air Test procedure or write for catalog covering recommended field installation details . . . and remember, it pays to do it RIGHT the first time . . .**

*Quality Piping Systems . . .*
*. . . of Exceptionally High Thermal Efficiency*

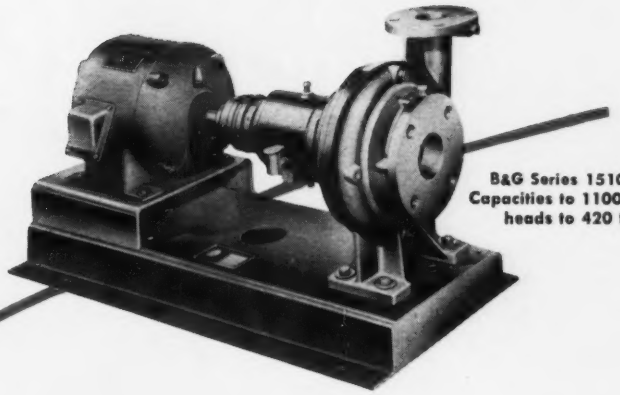
RIC-WIL PREFABRICATED INSULATED PIPING SYSTEMS

CENTRAL OFFICE: RIC-WIL INCORPORATED, BARBERTON, OHIO
WESTERN STATES: RIC-WIL INCORPORATED, WESTERN DIVISION, NEWARK, CALIFORNIA
IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED

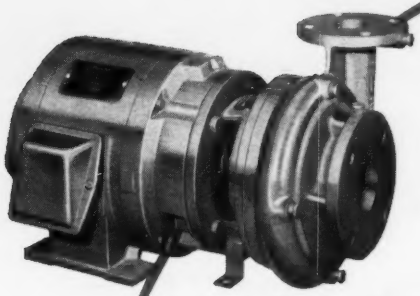


For more facts circle 868 on Reader Service card, p 197

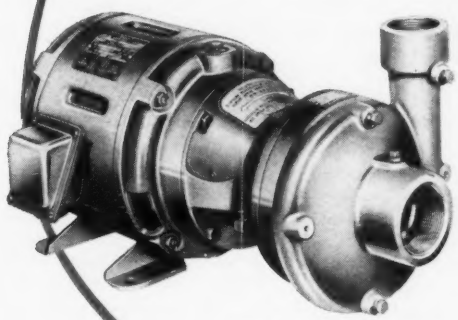
**A GREAT LINE OF PUMPS ALL EQUIPPED WITH THE...**



B&G Series 1510-B. Capacities to 1100 GPM, heads to 420 ft.

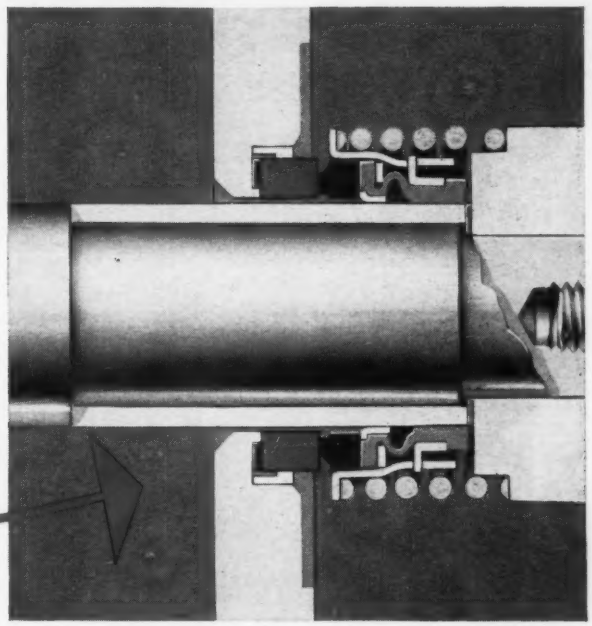


B&G Series 1531-B. Capacities to 1500 GPM, heads to 420 ft.



B&G Series 1522. Capacities to 150 GPM, heads to 115 ft.

# B&G "Remite"®
## MECHANICAL SEAL
**...an exclusive feature for leakproof operation**



Take just a moment to examine the design features of B&G Centrifugal Pumps. You'll find plenty of reasons why these pumps are giving trouble-proof performance through long years of service.

*Vertical split-case construction* permits removal of the bearing bracket without disconnecting pipe lines or motor leads. Solid cast iron volutes, with support feet in larger units, effectively prevent piping strain on the motor.

The shafts of B&G Centrifugal Pumps are an outstanding feature. Made of special alloy steel, they are super-finished and oversized to keep deflection at a minimum. The "Remite" Mechanical Seal—a B&G development—positively prevents leakage...and impellers are soundly designed to maintain hydraulic balance. An oil lubrication system, instead of grease cups, assures continuous protection to the long bronze bearings.

**Exclusive "Remite" Mechanical Seal**

This B&G feature eliminates the customary leakage which occurs where a packing gland is used. A Carbon Seal Ring faces on a "Remite" floating seat—*a new type of material, so hard it will scratch glass—wear-proof and corrosion-resistant.* Metal parts are of steel, bronze or stainless steel, depending upon the type of service. The B&G Mechanical Seal is self-lubricating.

**Materials of construction**

B&G Centrifugal Pumps are available as all-iron, bronze-fitted and all-bronze units. *Series 1522 Pumps are also available in stainless steel.*

**IMMEDIATE DELIVERY**
**ON PUMPS IN FACTORY STOCK**
**Available in commonly used sizes—capacities to 500 GPM, heads to 180 ft. Send for catalog CSP-360.**

# BELL & GOSSETT
**COMPANY**
**Dept. GV-36, Morton Grove, Illinois**

*Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ont.*



For more facts circle 869 on Reader Service card, p 197

District Headquarters, The Austin Company, Cleveland.

# When Engineer-Builders Build for Themselves . . .

# IT'S JOHNSON PNEUMATIC CONTROL

These two buildings were built, for their own use, by men whose organization has designed, engineered, and built thousands of industrial plants and commercial buildings.

As it has done for so many of its clients, The Austin Company has provided its own personnel with buildings that are attractive as well as highly functional. Both buildings are air conditioned, of course. And both are equipped with specially planned Johnson Pneumatic Control Systems to assure a consistently comfortable and productive working climate.

Wherever quality and performance are the key considerations, as they so obviously were here, you will usually find Johnson Control . . . a fact well worth remembering when you build or air condition. Johnson Service Company, Milwaukee 1, Wis. 110 Direct Branch Offices.

**JOHNSON CONTROL**

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

General Offices, The Austin Company, Cleveland.

For more facts circle 870 on Reader Service card, p 197

circle 871 on Reader Service card, p 197 ➤

# HARBISON-WALKER GUNNING, RAMMING AND CASTING REFRACTORIES

## A BRAND FOR EVERY SERVICE

| GUNNING | RAMMING | CASTING* |
|---|---|---|
| | Corundum Ramming Mix | |
| | Korundal Ramming Mix | |
| | Coralite Ramming Mix<br>Coralite Plastic Refractory | H-W Lightweight Castable 33 |
| Castolast G | H-W Mullite Ramming Mix<br>H-W Mullite Plastic Refractory | H-W Castolast |
| Apache Gun Clay | Apache Plastic Refractory | H-W High-Alumina Castable |
| H-W Chromepak<br>H-W Super Gun Clay | Apachite Plastic Refractory<br>H-W Super Plastic Fire Brick | H-W Lightweight Castable 30 |
| H-W Harcast BF | Coral Ramming Mix<br>H-W Black Patch | |
| H-W Kuplomix<br>H-W Standard Gun Clay | H-W Standard Plastic Fire Brick | H-W Lightweight Castable 28<br>H-W Harcast |
| | | H-W Super Castable |
| H-W Harchrome G | | H-W Chrome Castable<br>H-W Harchrome Castable<br>H-W Lightweight Castable 26<br>H-W Extra Strength Castable LI |
| | | H-W Standard Castable<br>H-W Baffle Mix |
| | | H-W Extra Strength Castable |
| | | H-W Lightweight Castable Extra Strength |
| | | H-W Low-Iron Lightweight Castable 22<br>H-W Lightweight Castable 22 |
| | | H-W Lightweight Castable 20 |
| | | H-W Lightweight Castable 10<br>H-W RC Castable |

*These products may also be gunned.

A complete series of gunning, ramming and casting refractories is available from Harbison-Walker to meet every furnace operating condition and temperature requirement. Harbison-Walker engineers will help you select the proper brands to assure best balanced service life. Write us for complete details.

TYPICAL FURNACE APPLICATIONS: ARCHES · ASH PITS · BOILER SETTINGS BREECHINGS · BURNER BLOCKS · BAFFLES · CATALYTIC REACTORS · DOOR LININGS · DUCTS AND PIPING · ELECTRIC FURNACE ROOFS · HEARTHS INSULATION · KILNS AND CARS · LADLE LININGS · ROTARY KILN CHAIN SECTIONS, HOODS, COOLERS AND DUST CHAMBERS · SOAKING PIT COVERS INDUCTION FURNACE LININGS

**HARBISON-WALKER REFRACTORIES CO. AND SUBSIDIARIES** *World's Most Complete Refractories Service*

GENERAL OFFICES: PITTSBURGH 22, PENNA.

# HARBISON-WALKER MONOLITHIC REFRACTORIES

## Now packaged for easy handling and time saving on job site

Newly-designed square-end bags, zip-open cartons and sturdy steel drums provide users of Harbison-Walker's monolithic refractories with easy handling, better palletizing and efficient storage advantages. A distinctive color for each brand speeds product identification on the job site.

The bags for packaging castables are made of sturdy, multi-wall, moisture-proof material. Brand names and mixing directions are clearly printed on each bag. The easy-to-handle zip-open cartons contain plastic refractory slabs wrapped in polyethylene moisture-proof material, insuring good shelf life. The results—besides easy and efficient handling—substantial savings of time and labor in installation.

**HARBISON-WALKER REFRACTORIES CO. AND SUBSIDIARIES** *World's Most Complete Refractories Service*

GENERAL OFFICES: PITTSBURGH 22, PENNA.

HW 61-15

# Your service center for FREE data

Either of the no-postage Reader Service cards below and p 197B will bring you FREE valuable additional information on any item listed in the Equipment and Design Aids Roundup and on any advertised product appearing in this issue. Here's all you need do to get this information:

- **Study New Equipment** described in the roundup starting on p 201. Circle numbers on card corresponding to items listed
- **Check Design Aids** surveyed, beginning on p 201. To order your personal copies of these bulletins, use the card below
- **Read advertisements** and note number listed under each ad. Circle ad numbers on card for complete details
- **Print your name and company on front of card**

**October 1961 issue** Circle numbers below for FREE data **Card void after April 1, 1962**

**NEW PRODUCTS reviewed, starting on p 201**

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# Engineer's bookshelf... A selection of basic

**Standard Handbook for Electrical Engineers, Ninth Ed,** *prepared by a staff of specialists; A E Knowlton, Editor-in-Chief. $21.00. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

The outstanding reference work on electrical engineering is updated in this ninth edition. It includes a handy compilation of usable data from all branches of electrical practice, plus the most frequently required fundamental theory, units and systems of measurement. Abundant and clear illustrations help explain electric circuits and operating principles of electric apparatus. Handbook is divided into 26 sections; subjects include: units and conversion factors, electric and magnetic circuits, measurements, circuit elements, transformers, regulators and reactors, ac and dc generators and motors, rectifiers.

**Electric Power Distribution for Industrial Plants, (No. 952),** *published by the American Institute of Electrical Engineers and prepared by its Industrial and Commercial Power Systems Committee. Third edition, now in preparation, should be available in 1962 from AIEE, 345 E 47th St, New York 17, N. Y., at $3.50.*

Widely known as the *Redbook,* this guide was prepared by leading industrial electrical engineers in the U.S. It's not an AIEE standard, but represents preferred practice. For the working engineer, the book gives fairly detailed information on system planning, voltage, protection, fault calculations, grounding, pf, power equipment, instruments, conductors and terminators. Cost figures compare design alternatives. (The *Graybook,* for commercial buildings, should be available in one year.)

**Power Station Engineering and Economy** *by B G A Skrotzki, Associate Editor,* POWER, *and W A Vopat, Head of Department of Mechanical Engineering, Cooper Union School of Engineering. 751 pp, 6x9, 405 illust, $12.50. McGraw-Hill Book Co, 330 W 42nd St, N. Y. 36, N. Y.*

Here are the basic principles of design and operation of all types of power-generating plants — the principal four—(1) steam (2) oil and gas engines (3) gas turbines (4) hydro turbines—plus a brief look at thermoelectric and thermionic plants, solar converters, wind turbines and tidal power plants. In addition to the basic engineering principles involved in power-plant design, this book includes the basics of making a rational economic choice of different types and sizes of plants—which one will best serve a given load.

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# references for the energy-systems designer

**Industrial Power Systems Handbook,** *edited by D L Beeman. $15.00. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

This thorough and practical guide to design of electric-distribution systems is prepared by a group of industrial-system experts (all are in the Industrial Engineering Section of the General Electric Co, Schenectady, N.Y.) Systems are detailed with many examples and a wide range of design data. Some subjects included: short-circuit-current calculating procedures, selection of ac s-c protective devices and circuit equipment, voltage considerations, overvoltages, grounding, pf improvement, overcurrent protection, selection of system voltages, load-center power systems and circuit arrangements, primary and secondary distribution systems, modernization of existing power systems.

**Standard Plant Operator's Questions and Answers,** *by Steve Elonka, Associate Editor,* POWER, *and J F Robinson, Board of Education, City of New York. Two volumes, 538 pp, 5⅜x8, 381 illust, $8.00.*

These two volumes are a basic question-and-answer guide to the energy systems. They should help (1) plant and building operators and engineers pass examinations and improve their knowledge (2) industrial and utility firms that have a training program for upgrading employees (3) professional and consulting engineers, for reference in many practical areas. The 20 chapters include boilers, steam engines, steam and gas turbines, pumps, instruments, electricity and vacuum tubes, refrigeration, air conditioning, heat exchange, cooling towers, nuclear power, lube. 54 pages list license requirements.

**Cameron Hydraulic Data, 12th Ed,** *251 pp, 5x7, $3.00. Ingersoll-Rand Co, 11 Broadway, N.Y. 4, N.Y.*

This pumping data book has been constantly kept up to date since it first appeared in 1926. It especially aims to aid users of pumping equipment in application and system design. Hydraulic terms are explained in an easy-to-understand way; data covers most common problems.

**Hydraulic Institute Standards,** *looseleaf, $6.00;* **Pipe-Friction Manual (Third Ed),** *$2.00. HI, 122 E 42nd St, New York 17, N.Y.*

Recently revised standard covers centrifugal, rotary and reciprocating pumps — nomenclature, hydraulic calculations, test methods, installation and operation. The separate *Pipe-Friction Manual* details pipe and fitting losses for common liquids.


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**Marks' Mechanical Engineers Handbook,** *edited by T Baumeister, Stevens Prof of ME, Columbia U. 2320 pp, 6x9, 2029 illust, $23.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N.Y.*

To have basic mechanical-engineering data on hand, this book is a must. It proves especially useful in design, operation and maintenance of energy systems, covering combustion, shaft power, refrigeration, compressed gases, radiant energy, hydraulics, heating, ventilating, a-c, lighting.

**Thermodynamics,** *by Joseph H Keenan, Prof of ME, MIT. 499 pp, 221 illust. John Wiley & Sons, Inc, 440 Park Ave S, New York 16, N.Y.*

Considered one of the basic texts of our times, this book covers the field of engineering thermodynamics in direct, terse style. It includes about all the fundamental theory on thermo that an energy-systems engineer might wish to use for the many and varied uses he's responsible for.

**Standards of the Heat Exchange Institute,** (4 parts), Heat Exchange Institute, 122 E 42nd St, New York 17, N.Y.:

**Standards for Steam Surface Condensers** ($2.00) covers nomenclature, definitions, performance, materials of construction, surface-condenser sizes, vacuum-pump capacity and atmospheric relief valves.

**Standards for Direct-Contact Barometric and Low-Level Condensers** ($2.00) includes, in addition to nomenclature and definitions, standards for selection, performance, construction and installation details.

**Standards for Steam-Jet Ejectors** ($3.00) gives operating principles, descriptions of ejector types—single and multistage—and details of inter- and aftercondensers. Design specifications are included.

**Method and Procedure for the Determination of Dissolved Oxygen** ($2.00) goes into approved reagents and their calibration, equipment, sampling methods, titration, reagent correction, computing results.

**Steam Power Plants—Starting, Testing and Operation,** *by C D Swift, Ebasco Services Incorporated. 490 pp, 6x9, 95 illust, $11.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N.Y.*

Here we have an integrated program for designing, building, starting, organizing crews—in short, how to run a successful power plant. All plant elements and systems are covered with special attention to critical conditions that need competent followup.

**Piping Handbook,** *by Sabin Crocker, Ebasco Services Incorporated. 1376 pp, 4½x7½, 334 illust, $15.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N.Y.*

A comprehensive reference for all types of piping systems: power plant, gas, oil, water, steam, plumbing and heating. Design considerations for the system include fluid properties, metallurgy of piping, selection of valves, fittings, supports and corrosion prevention.

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Scovill Heat Exchanger Tubes enjoy a first-choice reputation among outstanding plant operators because of the excellence of Scovill tube alloys . . . their superior uniformity and their close adherence to all specifications through extremely tight quality controls maintained by our tube mills.

The Port Wentworth Station of Savannah Electric & Power Company is a good example. Photographs show installation of tube in the split condensers in the No. 2 Unit at Port Wentworth, using 77,000 lbs. of Scovill Admiralty Heat Exchanger Tube ordered for this job. Cooling water is drawn from the Savannah River and has a salt content varying from 30 to 19,000 ppm. At times it may be contaminated by industrial wastes and sewage. Unit No. 2, placed in operation in May 1961 with a capability of 54,000 kw, doubles the capacity of Port Wentworth.

Draw upon Scovill experience as specialists in heat exchanger tube. It will be worthwhile talking to our technical men if you feel that an improvement in performance may be possible.

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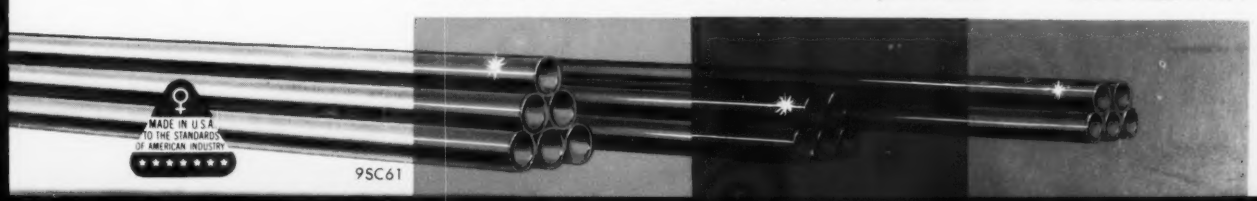


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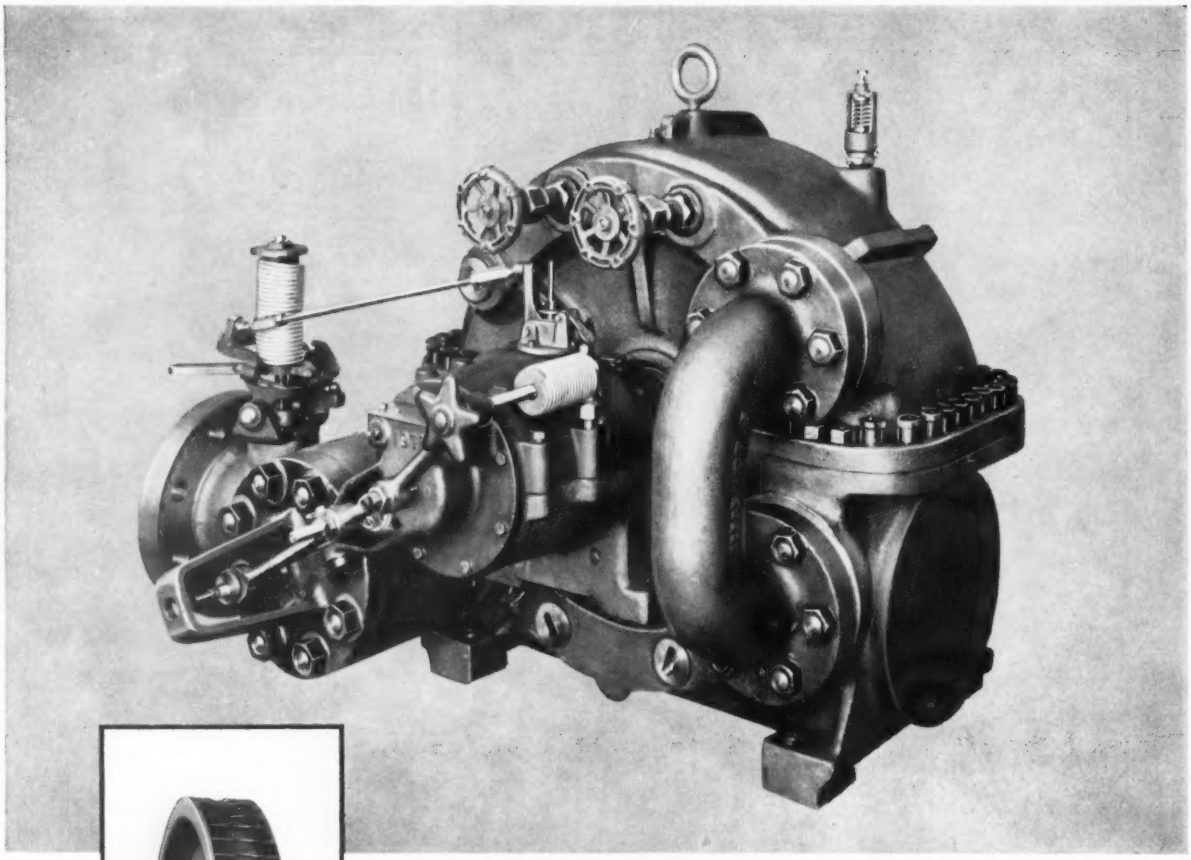

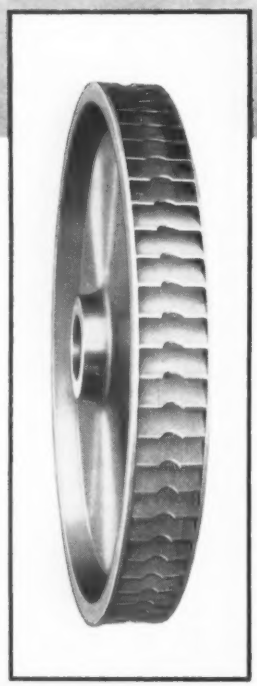

## solid-wheel turbine means performance instead of worry

In these days of automated production, proven reliability has come to be highly prized in a machine. That fact helps to explain the popularity of the Terry solid wheel. For here is a turbine designed from the start to be solid and simple . . . require minimum maintenance.

The wheel is a single steel forging. Unlike a built-up rotor there are no separate parts to loosen or work out. Since the effective steam action is at the backs of the buckets, wear does not affect efficiency.

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When you need continuous service, year in and year out, insist on Terry solid-wheel turbines.

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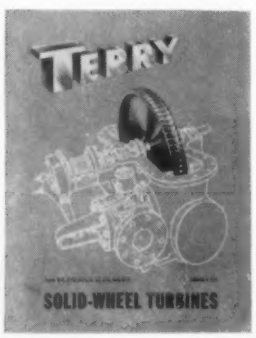


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*Discusses in detail the design and performance of the Terry solid-wheel turbine. Ask for bulletin S-159.*

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3

# Equipment and Design Aids roundup

On the previous pages we've looked at today's plant-design picture: industry girding for growth, central stations shooting to put out more energy, more economically. And these are the concerns of each energy-systems engineer: growth for his industry, coupled with greatest possible operating economy.

But what equipment is on the market to do the job at hand? Before you can choose specific equipment to best fit your system design, you need up-to-the-minute data on products available. For this reason we've carefully sifted the wealth of information made available to us over the past 12 months. Result: a selective survey of latest equipment and the recent booklets, brochures and bulletins issued by equipment manufacturers to help with your design problems.

This year we've included a bonus. On the next two pages we list some manufacturers' literature of lasting value: material rich in basic design information—nonographs, charts, formulas—that might find a place in your permanent reference file.

We hope this energy-systems-oriented roundup proves a valuable tool for plant design in 1962.


Literature of lasting value—202

General equipment and key materials

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# Selected free literature of significant

**To kick off this 1961 roundup of design aids, we asked leading makers of energy-systems equipment to nominate the one piece of literature that they felt would be of significant value to *Power* readers. Although not of necessity new, each such candidate must be rich in basic design data. On these two pages you'll find the literature that remained after *Power* editors screened the returns. It's free—circle key numbers on the Reader Service card, p 197**

## General equipment and key materials

**725** **Prefabricated insulated piping-systems** catalog charts steam flow. Tables included in 68 pp help estimate steam loads, give normal degree-days for U. S. cities, cover steel, copper-pipe and saturated-steam properties and pipe expansions. Ric-wiL Incorporated

**726** **Role of ball joints** in thermal expansion and contraction is subject of 8-p bulletin 31-B. Diagrams compare use of ball joints for expansion in place of pipe loops or U-bends. Barco Manufacturing Co

**727** **Steel properties** for elevated temperatures and high pressures are compiled to help you select right analysis of pipe or tubing to fit your requirements. 27 analyses list tensile, creep and rupture properties, effect of time and temperature on them and on notch impact strength and hardness. 72-p bulletin 26 is offered by National Tube Div of United States Steel Corporation

**728** **Calculations of pipe-hanger loads** and thermal movements at each hanger location are contained in 31-p booklet. Weights of piping materials are tabulated. Grinnell Company Inc

**729** **Piping-layout** diagrams show correct valving for each layout and indicate major pieces of equipment for each system. Includes: packaged-boiler and steam-desuperheater piping connections, automatic combustion controls and waste-treatment system. 36-p catalog is available from Jenkins Bros

**730** **Safety and relief valves** are subject of 144-p brochure 700B. Among the engineering data to be found: pressure-temperature ratings for steel pipe flanges and flanged fittings, ASME Power-Boiler, Unfired-Pressure-Vessel Codes. Manning, Maxwell & Moore Inc

**731** **Control valve** 41-p manual details installation, operation and maintenance instructions for manufacturer's valve. Flow-coefficient ratings for various sizes, material standards and face-to-face dimensions for cast and bar-stock valves are listed. A special slide rule helps size valves, calculate flow. General Kinetics Corp

**732** **Pvc pipe,** fittings and fabrications are topic of catalog. 28 pp feature friction-loss tables, chemical-resistance and flow-rate charts and general cutting, welding and handling info. The Colonial Plastics Mfg Co

**733** **Sizing** chart JSC-1 applies to manufacturer's sliding-gate regulators and control valves. Data on adjusting sizing for pressure, temperature, viscosity or specific gravity applies to all valve makes. OPW-Jordan

**734** **Diaphragm control valves** are topic of 59-p bulletin E-600. Body materials and construction listings prepare reader for main portion of bulletin where tabulations and diagrams facilitate valve selection. One chapter covers maximum-pressure-drop values used to determine actuator size. Fisher Governor Co

**735** **"Friction** as a factor in bolt tension, galling, seizing" is title of 9-p reprint. Presents case histories on role of molybdenum-disulfide lubricants in preventing galling and seizing. The Alpha-Molykote Corporation

**736** **Expansion-joint** catalog 222 comes in three parts; part *A* contains comparison table of methods of absorbing pipe motion, design data and thermal expansion and angular-, lateral-movement charts. Parts *B* and *C* deal with high-, low-pressure compensators and pipe guides. Flexonics, Div of Calumet & Hecla, Inc

**737** **Gasket materials**—their resistance ratings and proper selection—are discussed in 23-p catalog AD-190. Common faults in gasket design and their suggested remedies are diagramed. Garlock Inc

**738** **Stainless-steel condenser tubing** is spotlighted in 10-p publication. Discusses brackish- and sea-water applications, compatibility with other metals, vibration and maintenance. Allegheny Ludlum Steel Corporation

**739** **Seamless-steel condenser** and heat-exchanger tubing info is found in 10-p booklet. ASTM specifications, condenser-tube bursting pressure and recommended minimum bend radii for U-tubes are tabulated. Michigan Seamless Tube Company, Gulf States Tube Corp

**740** **History of the heat-transfer tube** is detailed in 30-p engineering data book, section 1. Subject of corrosion is examined and materials for design are described. Wolverine Tube, Div of Calumet & Hecla, Inc

**741** **Shell-and-tube heat exchangers** are feature of bulletin 101. Setting plans, stacking, shell-side flow-area data are found in the 24 pp. The Griscom-Russell Co

**742** **Proportioning of surface condensers** is topic of 20-p manual. Sample problems are given. Calculating performance is simplified by using charts—relation between temperature rise, range and logarithmic mean temperature difference; absolute-pressure-limit curve for steam-turbine service. Allis-Chalmers Mfg Co

**743** **How to select worm gearing** and calculate bearing loads is discussed in 28-p bulletin 3800S. Along with design data—lube, seals, worm-bearing fits—ratios and hp ratings are given. De Laval-Holroyd, Inc

# reference value to energy-systems designers

**744** **Insulation** product catalog IN-244A gives specifications on insulations for various applications in its 64 pp. Example: high-temperature, heating, air-conditioning and refrigeration applications and insulating firebrick and refractories. Johns-Manville Sales Corporation, Industrial Insulations Div

**745** **Spray equipment** questions and answers give info on unit's maintenance, installation and operation. Diagrams in 64 pp accompany answers to questions on air compressors, transformers, regulators, condensers and hose connections. The DeVilbiss Company

**746** **High-strength and alloy steels** for structural design are topics of literature found in kit covering mechanical properties, fabrication, application and welding. The 168-p design manual includes chapters on tension, compression, shearing stress. United States Steel Corp

## Air-conditioning systems

**747** **Natural-draft cooling towers**—their history, erection, resistance, economics and packing—are detailed in 22-p bulletin. Chapter on operating features includes performance curves. Hamon, Inc

**748** **Cooling-tower** 12-p brochure contains nomographs and charts designed to provide selection data for towers in the 75- to 500-ton range. Fluor Products Co

**749** **Safety controls** are diagramed in 22-p bulletin ERS-A. Typical liquid-level and flow-control applications: chilled and condenser cooling-water systems, standby pump operations, open-expansion, compression, oil-storage tanks. McDonnell & Miller, Inc

## Electric systems

**750** **"Basic protection for electrical power systems"** is title of 11-p handbook BPB. Gives definitions of terms, contains sections on motor protection, systems' selectivity to faults and fuse selection. Charts show time of opening and current-limiting effect of fuses. Bussman Mfg Div, McGraw-Edison Co

**751** **Batteries** for switchgear control and emergency light and power are subject of 24-p brochure section 58.00. Selecting and tripping batteries, effect of temperature on capacity are subjects discussed. Exide Div, The Electric Storage Battery Company

## Steam and hot-water systems

**752** **"Calculating heat loss** through furnace walls of various materials" is title of 9-p pamphlet. Using formula and charts you can figure cold-face temperatures, determine temperature at junction of a 2-component lining and compare heat and fuel savings of various wall constructions. Plibrico Company

**753** **"An introduction to boiler feedwater** treatment," 24-p booklet 30, answers basic questions like: How pure must feedwater be? How does operating pressure influence boiler-water requirements? What are "external" and "internal" treatment? Nalco Chemical Co

**754** **Flame safeguards** are feature of 32-p bulletin. Publication shows how to use manufacturer's unit to form engineered systems for large boilers. Terminology is given and each system diagramed. Minneapolis-Honeywell Regulator Company

**755** **Steam-trap** book includes tables on properties of saturated steam, thermal expansion of pipe and standard dimensions for schedule-40 pipe in its 48 pp. Armstrong Machine Works

**756** **Impulse-steam-trap** selector for petroleum-processing equipment details the equipment, its purpose and trap recommended. Capacity tables are set up to select trap for maximum operating rates of equipment for any given steam pressure and process temperature. Piping diagrams wind up the 26 pp. Yarnall-Waring Company

**757** **"How to select steam traps** and other fluid specialties" is title of 36-p product catalog. General info on function, selection and sizing of a steam trap is given. The V D Anderson Company

**758** **Coal-preparation** manual illustrates maker's equipment. Engineering-data and reference-table section of the 152-p handbook contains fuel- and power-conversion factors, bulk-material characteristics and conversion tables. McNally Pittsburgh Mfg Corp

## Fluid-handling systems

**759** **Compressor** data booklet SP-3285 defines terms, devotes 15 pp to engineering charts and tables. Examples: temperature-conversion chart, temperature-rise factors vs compression ratio, loss of air pressure due to pipe friction. Chicago Pneumatic Tool Company

**760** **If you use water,** this 24-p brochure may be of use to you. Water softening by ion exchange, reduction of alkalinity, deionization and silica removal are chapters. Rohm & Haas Company

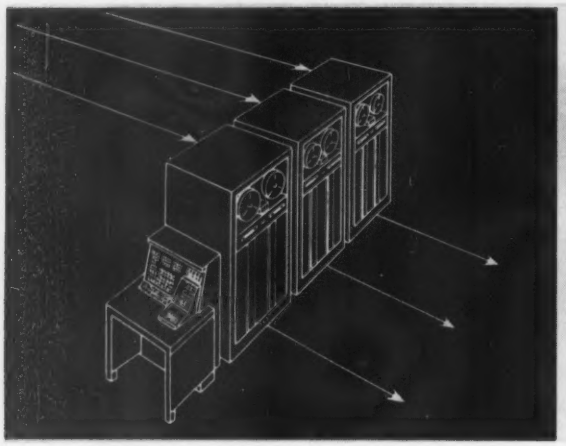
**761** **Water-treatment** 24-p bulletin 615 presents latest equipment being used—automatic and manual zeolite softeners, ion exchangers—and operation of each. Elgin Softener Corporation

**762** **Pump book,** 44 pp, holds wealth of info on viscosity—conversion, table showing viscosity of common liquids, effect of temperature on fuel- and turbine-oil viscosity and a blending chart. De Laval Steam Turbine Co

**763** **Hydraulic** data is topic of 16 pp. A sample problem shows you how to use tables for water. Among tables given: friction loss, resistance coefficients for valves, fittings, bends and reducers. Goulds Pumps, Inc

**764** **Rotary-pump** 36-p manual gives fundamentals on vapor pressure, viscosity, capacity and hp while defining each. Viking Pump Company

# GENERAL EQUIPMENT AND KEY MATERIALS



Automatic control for power units finds ever-broadening acceptance (see pp 153 and 158, this issue), as do its first cousins, data logging and electronic performance calculation. And the solid-state hardware so necessary to this growth is readily available. Ingenious versions of familiar instrument types—pressure and temperature gages are but two examples—are coming on the market almost daily to assist the designer. How far will automatic control go? No one knows for sure, but the future seems limitless.

F. W. Edwards

Associate Editor

## Instrumentation equipment designs

1 **Electronic computer** PB 250 normally operates from a standard 115-v power line, but it needs so little power that you can rig it up with a battery supply, use for emergencies or where power is erratic or unreliable. During operation, trickle-charging continuously regenerates battery. If 115-v input is interrupted, computer can continue for one hr or more. Battery supply uses sealed cells operating five years without service. —Packard Bell Computer

2 **Industrial control computer** comes in a broad range of capabilities. You can buy a minimum installation, limited to requirements of the application, and expand it later. The digital computer's memory capacity can be supplied in a range from 4000 to over 100,000 words—special commands can be added. Programs run at 600 to 1200 operations per sec.—TRW Computers Co

3 **Buy computer off-the-shelf**—standard system is packaged for sale to electric-power-generating stations. That is, the system needs minimum special programing to adapt to any steam station, reducing installation time to less than a month. System comprises a central computer with 24,000-word drum memory expandable to 52,000 words and a build-in calculating and checking program. Price of a minimum GARDE system to monitor and log is in the neighborhood of $200,000; delivery time: ten months.—General Electric Co, Industrial Control Dept

4 **Pneumatic analog computer** for process control offers a low-cost building-block approach. Using standard 3- to 15-psi pneumatic inputs, unit will add, subtract, multiply and divide, take ratios and sq root, integrate, differentiate, etc. Accuracy and long life are features. Approximate price: $500 for a 4-function module.—AiResearch Manufacturing Div, Garrett Corporation

5 **General-purpose GE 225 computers** will now be available equipped with the GECOM programing technique to automatically translate English-language instructions into code, and TABSOL, a systems-oriented method of describing the decision-making process in tabular form.—General Electric Co, Computer Dept

6 **Pure electronic system** monitors, controls alarm and remote station on-off functions from central station—lets power substations, pumping plants, pipeline and similar installations go completely unattended. Solid-state circuitry throughout means unit uses no relays, stepping switches, motor-driven commutators or rotating switches. Time-division multiplexing codes each function—go-no-go, start-stop, on-off. Unit is capable of scanning and controlling up to 36 separate functions in 40 milliseconds. A transistor user, unit is pint-size but speedy.—Lynch Communication Systems Inc

7 **Transistorized alarm scanner** checks up to 200 measured variables at the rate of one point per sec. Instrument activates a recorder and alarm lamp and energizes any external alarm system. On completion, it returns to normal scanning and alarm lamp is left on until reset button is depressed. Alarm-condition measurement and location are recorded.—Bristol Company

8 **Simplified supervisory system** handles control and indication of a single device—breaker or motor contactor, for example—at a remote station. System applies where master and all remote stations are located in a relatively small area, to keep down loop resistance of line-wire channel.—Westinghouse Electric Corp

9 **High-speed low-level differential system** features versatile format control producing data accepted by most computers. Modular design can accept all types of electrical signals representing different variables requiring measurement. Solid-state data-reduction system processes both operating and test data. System has three components: high-speed scanner in 10-channel multiples, high-speed analog-to-digital converter and output format control. You can directly connect inputs such as thermocouples, strain gages, pressure, flow and level transducers and qualitative and quantitative analyzers.—Electro Instruments, Inc

**10** **Digital clock** provides split second-to-second timing. There are five drums, for 1 hr, 10 min, 1 min and two to count the seconds. Easy-to-read digits are 5/8-in. high on the 12-hr and 5/16-in. on the 24-hr clock.—Pennwood Numechron Co, Electronic Timing Div

**11** **Multichannel data system** operates unattended, allows transmitting signals as small as 10 microvolts for distances up to 1000 miles with accuracies of 0.1%. Unit will monitor up to 250 channels of low- or high-level data on temperatures, pressures, displacements and voltages. It steps from one channel to the next at ten readings per sec.—Communications Control Corp

**12** **Camera goes where man can't**—television system for line inspection is submersible, has its own lighting system. Camera is pulled through pipe—sometimes as small as 4-in. ID—by a cable. Technician watches monitor in mobile viewing room, phones speed and movement instructions to an operator. Price: $6500.—Inspectoline, Inc

**13** **Closed-circuit television system**—transistorized camera, pickup tube and separate camera-control and power-supply unit—keeps an eye on things in the plant. The 7¾-lb camera has a 25-mm f 1.9 lens. Designed for complete remote control, system can be portable or operate as an automatic permanent installation. Price is $695.—Packard Bell Electronics

**14** **Adjustable span and zero recorder** ends external calibration. Two settings—zero and span—let you measure an unknown simply by changing dial settings—there's no time-consuming calibration. 1-mv span and 1-sec cross-chart speed are standard. Span accuracy is ½ of 1% of the set value. Zero settings are accurate to ½ of 1%; you can read them at a glance. Adjustments are simple to make and there are only three: calibrated span vernier, calibrated zero vernier and arbitrary amplifier-gain control. Calibrated zero vernier gives any value from 0 to 50 mv of suppression for exact settings. A feature: when one dial is set you can set second dial without changing already-set dial.—Barber-Colman Company

**15** **Strip-chart 1- and 2-pen recorders** use null-balance principle for measuring. This principle compares output of an external-linear-variable differential transformer with a signal derived from an internal transformer. Both are 1-v distribution type. The position of balance system is indicated by pen on chart. Model MR2SL has two null-balance systems mounted side by side to record variables simultaneously, correlating events to a common time base.—Schaevitz Engineering

**16** **Recorder mounts like meter**—miniature circular-chart unit records any electrical signal. 3¾ x 3¾ x 3 in. deep, it may be panel-mounted or mounted in a meter enclosure for outdoor use. As a demand meter it checks regulator loads and 3-phase load balance, also records line voltages. No pen, ink or ribbon are required; graph is printed by a stylus on pressure-sensitive paper.—Instrument Div, Thomas A Edison Industries

**17** **Transmitting rotameters** for flows to 50,000 psi make direct measurement possible. Four sizes have capacities from 0.90 to 47.0 gpm—higher capacities can be achieved by installing meter in a bypass with the orifice plate in main pipeline. Meters feature integral pulsation damping; they operate on a dashpot principle.—Brooks Instrument Company, Inc

**18** **Rotary positive-displacement meters** measure gas at pressures to 125 psi. Connections are flanged for mounting in 3-in. pipe, and no special supports are needed for vertical or horizontal mounting. Oil replenishment is only maintenance required—bull's-eye oil-level gage tells how much.—Roots-Connersville Blower Div, Dresser Industries

**19** **Ac voltmeters** and ammeters feature low cost and accuracy. New case design and reduced flange dimension (4½-in. square compared to 6½x7 in.) cuts unit's cost. Scale length is 5.1 in. covering 180 degrees. Ammeter rating is five amp; voltmeter is rated 150, 300, 500 and 600 v.—General Electric Company

**20** **1-lb sound-survey meter** is inexpensive but highly accurate. Fully transistorized circuitry makes it a rugged and stable performer. Hand-held instrument samples noise in factories, offices; with its matched pickup, meter can be used to test vibration. Large scale measures sound-pressure levels from 40 to 125 db. Frequency response is said to be well within ASA tolerances in the 45 to 8000-cps spectrum. Vest-pocket measurements: 5x3¼x1½-in.—The Korfund Co, Inc

**21** **Strain-gage balance "pot"** achieves infinite resolution. New industrial-process potentiometer has an electromechanical strain gage to replace conventional slidewire balancing element. For the first time, resolution—the number of points at which a potentiometer can come to balance—is infinite. Four looped-wire strands form variable-resistance legs of a measuring circuit; their resistance varies in proportion to tension. Other features of the basic pot: all critical components are electrically shielded to reject stray signals, avoid recording errors. Transistorized plug-in control units provide a maximum eight set points for auxiliary or zone control. Pots are supplied as original equipment in any combination or you can modify to suit in your own plant.—Minneapolis-Honeywell Regulator Co

**22** **Position indicator** gives continuous meter reading up to ten ft of mechanical travel or fluid flow. Traveler or float rides along probe. Probe mounts directly or remotely to direct-reading receiver. Follower within probe is magnetically coupled with moving traveler to shunt out part of a resistive circuit, and the receiver meter connects to this circuit.—The Gems Co, Inc

**23** **Indicating instruments** for measuring dc volts and amperes use both taut-band suspension and core magnets. Ammeter measures from 20 microamp to 50 amp, voltmeter from 35 mv to 800 v. Both instruments can be used in magnetic fields up to 500 gausses.—Westinghouse Electric Corporation

**24** **Economy monitor** checks one to ten points for the same value—temperature, pressure, speed, pH, flow. Each point is scanned in sequence—at a speed of 1 to 10 sec per point—and its value compared to a pre-established setpoint. Ten red lights indicate scanning position.—Thermo Electric Co, Inc continued

**25** **Fast 16-point multirange recorder** uses four groups of four points. Range change is automatic from one group to the next in these ranges: 1-, 2-, 5-, 10-, 20-, 50-mv dc. Each group of four points prints in a different color.—The Indikon Company

**26** **Magnetic rotameter** indicates abnormal high or low flows, activates warning light or alarm device, will start or stop a pump, motor or control unit. It uses a standard 5-in.-scale glass tube and a sensing system. Float extension rod with encapsulated magnet extends into stainless-steel housing tube which mounts switch assemblies.—Schutte and Koerting Company

**27** **Magnetically attaching, bimetal dial thermometer** comes in three styles: for measuring temperature only; with maximum reset hand; electric contactor permitting on-off temperature control with electric resistance or induction heating. Range is −60 to +700 F. Applications include measuring and controlling preheating for welding; steel tank, vessel and pipe process control and checks.—Industrial Service Co

**28** **Temperature controller** gives automatic 2-position control for ten processes. Unit saves space, cuts installation and maintenance time. Use as single-point controller, 5-point 3-position controller and manual-balance indicator—and you can monitor other processes with points not used for controlling multiple-temperature process. Controller combines sensitive null-balance-pot measuring circuit with electronic control system. Accuracy is 0.5% of range.—Thermo Electric Company, Inc

**29** **Double-target control** indicates temperature. Electronic on-off controller gives second control point for secondary or additional action. Besides controlling temperature, pyrometer can independently open or close a valve. Ranges: from 0 to 400 to 0 to 3000 F.—Alnor Instrument Company

**30** **Thermocouple type sensors** for use up to 4000 F are available cooled and noncooled to measure liquid, solid and gas temperatures. They're made of refractory metals—oxidation-resistant coatings, magnesium and beryllium insulation and iridium, tungsten and rhenium wires. Applications include measuring afterburner exhaust gas, combustion processes and flue gas.—Aero Research Instrument Co, Inc

**31** **Disconnect serves as thermocouple head**—base and terminals of thermocouple heads and connectors are imbedded in waterproof and weatherproof molded-neoprene body. There are no threads to corrode or bind. You simply make or break circuit by hand. Disconnect can be used for thermocouple assemblies, as thermocouple head or as lead-wire junction up to 16-ga wire sizes.—Gay Sales Company

**32** **Temperature probe** has concentric shields surrounding a thermocouple element inside a ¼-in. protective tube with inlet and outlet slots. Use these probes to measure gas temperatures over 1000 F at velocities over 300 fps, where limited space won't let you install larger, shielded probes.—United Sensor & Control Corp

**33** **Temperature regulators** for storage heating and cooling applications are single seated, diaphragm actuated with lever type internal pilot. There are only two moving parts—no close-fitting parts to clog, bind or seize. Temperature variations are sensed by a liquid-filled thermal element, fully interchangeable with regulator on the line.—Leslie Company

**34** **Controlled-speed system** for centrifugal pump and fan drives provides variable speeds from induction motors. Signal from small potentiometer controls speeds. Pot can be actuated by liquid level, temperature, pressure.—U. S. Electrical Motors, Inc

**35** **Miniature inertia switch,** model 6UO-200, is preset to respond to acceleration forces up to 250 G within a tolerance of ±15% of setting. Switch has one moving part—steel ball held against a solid base by uniform magnetic field—which moves to close an open electrical contact. Range: −65 to +200 F.—Inertia Switch, Inc

**36** **Magnetically controlled start-stop system** is specially designed for electric-power switching at unattended facilities. Unit monitors both primary and secondary power sources, performs all necessary switching for continuous power. Start-stop control automatically starts a diesel- or gasoline-generator set when primary power is interrupted. When auxiliary system reaches proper voltage and frequency value, control blocks out primary source and transfers load.—Lumen, Inc

**37** **Electronic vibration control** protects equipment and processes against damage from excessive vibration. It is sensitive to 2-millionths-in. amplitude. Described as a resonance type vibration monitor, it flashes signal or stops machine if vibration amplitude gets dangerous. Feature: unit will pick out vibration frequencies for which it has been set, filter out extraneous vibrations through mechanical resonance. Applications include gas-turbine engines, pumps.—Stewart-Warner Corp

**38** **Wells** are available in any immersion length up to 12 in. on special order—for use with thermocouples, bimetallic thermometers and test instruments.—Trinity Equipment Corp

**39** **Leakproof sensing device** for detecting control of process variables uses wire-in-tube element for transmitting motion through pressuretight wall without bellows, seals or stuffing boxes. Element is flexible tube with spring wire inside.—Yarnall-Waring Co

**40** **Pocket-sized calibration tester** simulates dc electrical output of transducers with 0.05% setting accuracy. It matches transducer curve in direct or indirect reference terms. A 8-oz direct-reading source tests the recording or indicating instrument in millivolt or microvolt range.—Howell Instruments, Inc

**41** **High-accuracy power computer** (transducer) meters, records or monitors. You can use it as a demand indicator or feedback control. Operating without moving parts, PC-500 produces dc-voltage output proportional to true power. Frequency range: from 50 to over 1000 cps.—Ohio Semiconductors

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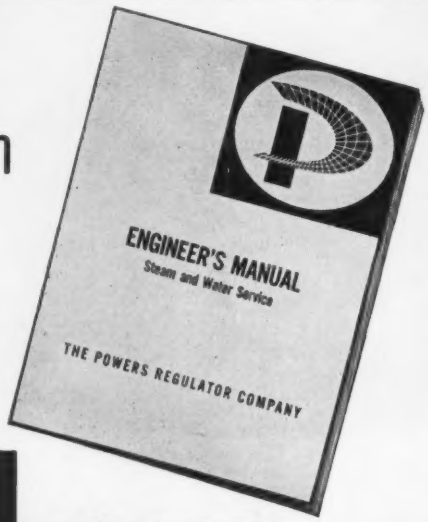


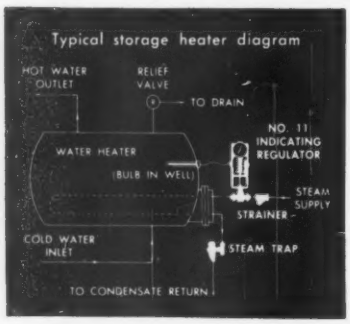


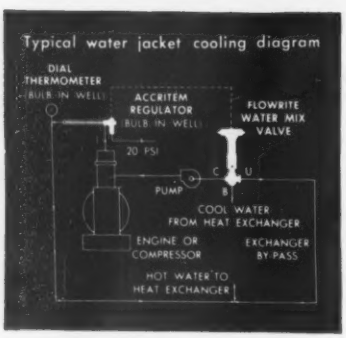


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## Instrumentation

Begins on page 204

**42** **All-transistor annunciator** has no moving parts and no relay contacts to pit or corrode. It operates when a set of remote contacts opens or closes. Indication area measures 2 x 3 in.—Radiation Technology, Inc

**43** **Voltage comparator** keeps regulator informed regardless of frequency. Using bridge circuit of zener diodes and resistors with magnetic amplifiers, it is effective for hydro installations where water-control valves cannot close quickly enough to compensate for turbine overspeeding. Circuit imposes lower burdens on transformers. — Allis-Chalmers Mfg Company

**44** **Digitizer** is easily installed on recorder—this kit adapts digitizer to ¼ sec Minneapolis-Honeywell Brown recorders. Installation uses existing mounting on recorder, requires no drilling or tapping. Digitizers provide 1000 counts for full-scale deflection of recorder pen, low driving torque and inertia values. — Coleman Electronics, Inc

**45** **Temperature-compensated test gage** is said to hold high degree of accuracy in wide temperature range. You can use it as a portable test instrument. Temperature compensation is built into both bourdon tube and linkage. Bourdon tube is made of high nickel alloy to minimize effect of temperature on spring rate. — United States Gauge Div of American Machine & Metals, Inc

Just circle key numbers on the Reader Service card, page 197, to get complete product story

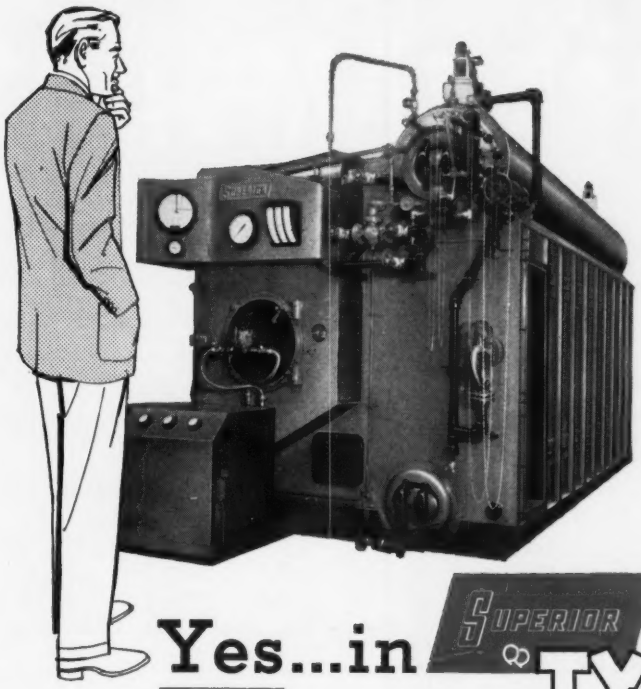
## • Instrumentation design aids

**255** **Mathematical applications** of storage analog computer: topic of 16-p technical report available from Computer Systems, Inc

**256** **High-speed basic,** medium and large computer systems are depicted in 20-p brochure QC-020-R110. Chapters include programing, accessories and specs. Bendix Computer Div

**257** **Computer selection** is topic of 5-p nontechnical booklet. System analysis, specs, design and

# *are the* Tube-Holes Serrated?



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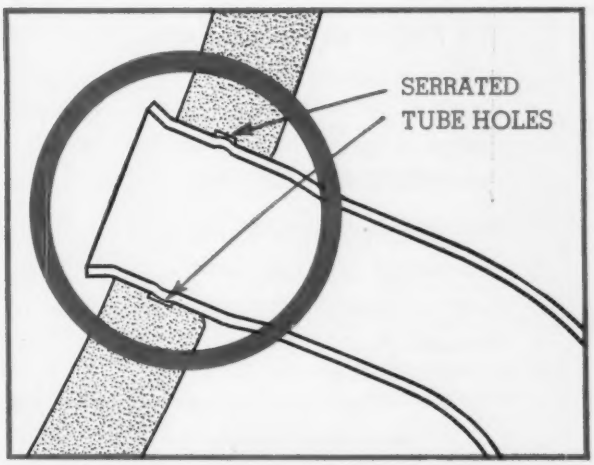


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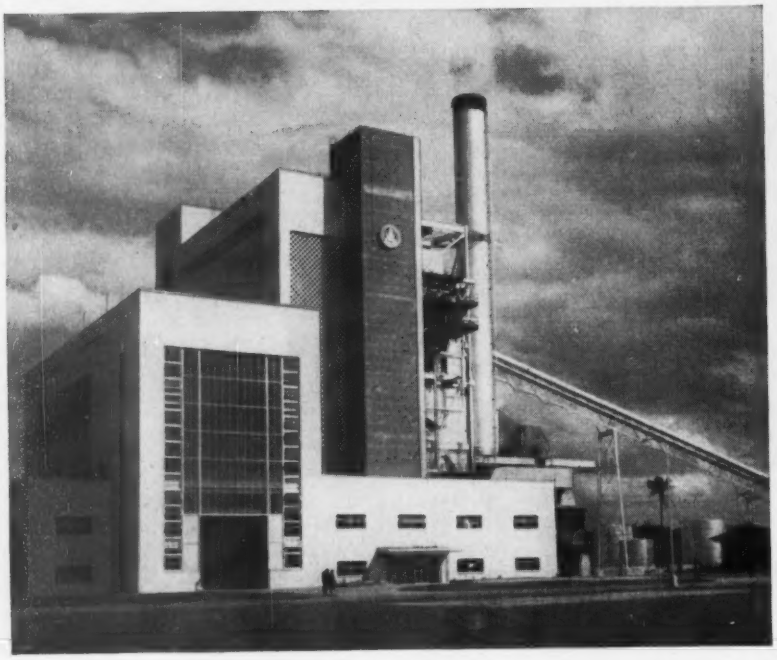

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## Instrumentation

*Begins on page 204*

operation of computer are given. Philco Corp, Computer Div

**258** **Analog computer,** storage type, is subject of 9-p report 80-105-008. Includes mathematical equations, diagrams, info on installation. Computer Systems, Inc

**259** **Computer** combines features of analog and digital to handle problems of partial differential equations, statistical iteration. Illustrated 20-p catalog also presents accessories of central computers. Computer Systems, Inc

**260** **Multiplexing system** expands to 600 channels for communication requirements—introduced in 12-p brochure. It's said to be practical for small or large users. Lynch Communication Systems Inc

**261** **Automatic programing** systems for digital computers are discussed in 8-p brochure AR-1060. Coded illustrations of typical problems are included. Bendix Computer Div

**262** **Translator** for programed and remote positioning and indexing and indicating is illustrated in 4-p folder SS361. The Superior Electric Company

**263** **Programing aid** means the programer need not speak his machine's language like a native. Brochure describes automatic system for use with manufacturer's equipment. Minneapolis-Honeywell Regulator Co, Electronic Data Processing Div

**264** **Automatic sequence control** for pneumatic materials-handling systems is described in 4-p circular EEb. Dimension drawings and schematic diagram for typical system are included. Allen-Sherman-Hoff Company

**265** **Self-policing annunciator** systems for industry are explained, illustrated in 36-p catalog 659. Topics covered: how annunciators function, sequences, the plug-in relay. Illustrations include field-wiring and electric diagrams. The Scam Instrument Corporation

**266** **Solid-state electric control** systems producing variable outputs in accordance with desired or set-point conditions are illustrated in 4-p bulletin E74-1. Bailey Meter Company

**267** **Electronic monitoring** system using error-checking circuits and solid-state components is subject of 8-p booklet. Applications include circuit breakers, motor-driven valves and pressure switches. Lynch Communication Systems, Inc

**268** **Automatic-control-system** manufacturer offers 24-p brochure

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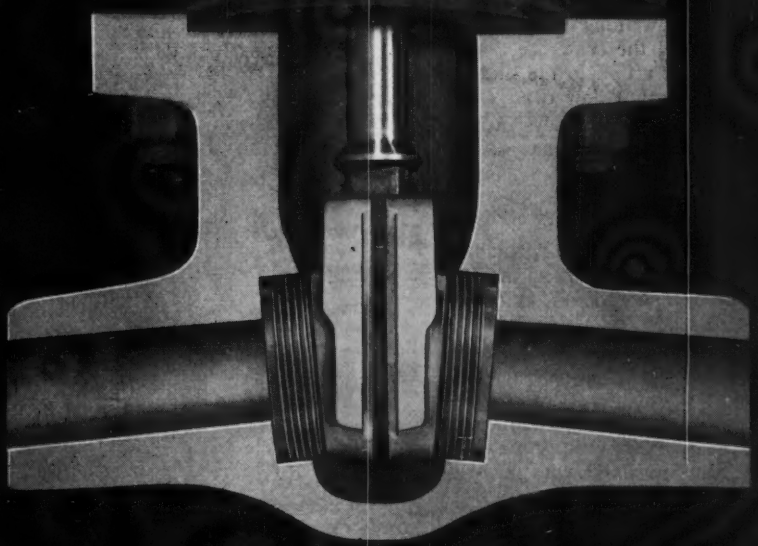

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8. Replaces double valving under certain conditions
9. Unaffected by pipeline strains, temperature swings, welding heat or other loads induced by the pipeline
10. Will not stick when closed hot and opened cold
11. Maintenance time and cost drastically reduced
12. Available in sizes from 2" up, all pressure classes in steel at no increase in price

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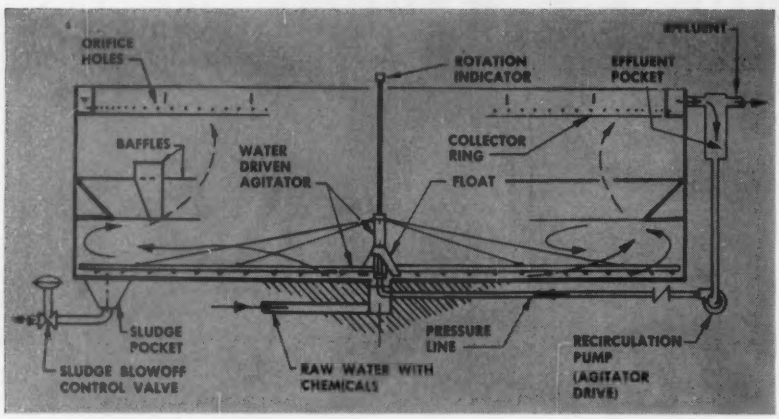
# FLUIDICS SPOKEN HERE

*Water treatment news*




## NEW TYPE M PRECIPITATOR
### ...a study in simplicity

by D. Miller, Technical Manager, Permutit

Now in operation is this new precipitator for reducing turbidity and color in water.

We call it the Permutit Type M Precipitator. It is a study in simplicity, and because of its low construction and operating costs, it opens up new opportunities to obtain solids-contact clarification at minimum cost.

**"Missing" parts:** There is no motor-driven agitator on the Permutit Type M Precipitator. No extensive baffling. No center platform. No access walkway. All these have been done away with, because the unit has a new and different agitator system which sweeps away the settled sludge. Rotating agitator arms are supported by a "semi-buoyant" hub (or float) which revolves about a bearing post on the tank floor. Recycled effluent drives the agitator through jet nozzles located at the end of each arm. Smaller jets, spaced along the arms, gently nudge the settled sludge toward a sump at the outer rim of the tank floor.

Briefly, this is how the M unit works: raw water and chemicals are mixed in line and enter at the center of the tank floor beneath the conical rotor float which deflects the fluid mixture radially outward to the walls. A horizontal baffle on the tank wall then reverses the flow back toward the center thus imparting a rolling action to the sludge blanket. This current flow constantly places previously formed sludge in intimate mixture with the raw water immediately as it enters the tank. Clarified, effluent is collected by a flume at the top.

**Sudden water changes:** An additional benefit of the Permutit Type M Precipitator is its exceptional ability to handle shock loads.

A case in point: red dye from a paper mill a mile upstream showed up one day in the raw water entering a Permutit Type M Precipitator in use in New England. But the unit went right on putting out an effluent with no significant change in quality.

So much interest has been shown in this new unit that we have reprinted the paper, "A Recent Development in Solids Contact Clarification Design", by E. D. Driscoll of Permutit. We'll be glad to send you a copy.

Write to Permutit Division, Dept. PO-101, 50 West 44th St., New York 36, New York. (In Canada, contact the Permutit Company of Canada, Toronto.)

**PFAUDLER PERMUTIT INC.**

Specialists in FLUIDICS...the science of fluid processes


## Instrumentation

Begins on page 204

describing his products and research, development and manufacturing. CompuDyne Corp

**269** **Electronic process-control** system, closed-loop type, is topic of 8-p brochure 10. Capacitance-actuated level-detection and control units as well as malfunction detectors are described. Robertshaw-Fulton Controls Co

**270** **High-speed electronic** temperature monitor is subject of reprint 100. Unit scans up to 3600 inputs in 0.8 sec. Monitor Systems, Inc

**271** **Frequency-response** fundamentals and terminology are covered in 12-p paper TM-6 available from Fisher Governor Company

**272** **Television monitors** are shown in 4-p booklet ECL 92. Cabinet- and rack-mounted units have 14-, 17- or 21-in. screens. General Electric Communication Products Dept

**273** **Remote-control code printer** for strip charts is described in bulletin 130. Royson Engineering Co

**274** **Pilot regulators** using own output as control medium are feature of bulletin 140. American Meter Company

**275** **Gages** feature integrally cast solid wall for explosion protection. Details are given in bulletin from J E Lonergan Co

**276** **Test gages,** depicted in 8-p publication 363, are used by engineers checking and calibrating pressure instruments in shop, laboratory or field. Manning, Maxwell & Moore, Inc

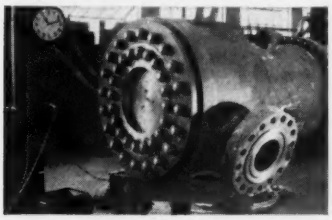
**277** **Receiver gages,** dial-indicating type, have range of 3 to 15 psi. Details are in 8-p catalog 520 available from United States Gauge Div of American Machine and Metals, Inc

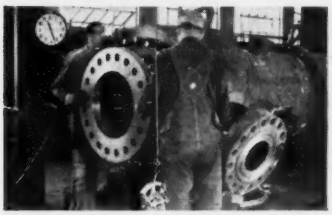
**278** **"Instrumentation** for electric power generation" is title of 64-p booklet B91-30. Covers boiler, turbine, generator instrumentation; includes basic circuit diagrams. Minneapolis-Honeywell Regulator Company, Industrial Products Group

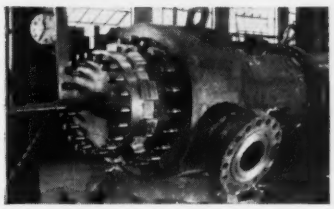
**279** **Industrial controls** are topic of 87-p brochure. Actuators, contactors, gas and air controls, magnetic valves are some equipment pictured. General Controls Co

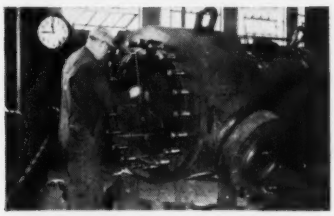
**280** **Idea book** features special and unusual gage assemblies and solution to common gaging problems in its 84 pp—available from Boice Gages, Inc

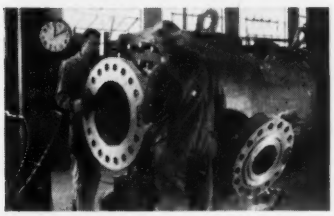
**281** **Indicating gages** are topic of 32-p catalog DH-54. Illustrates construction features, operation, calibration and adjustment of

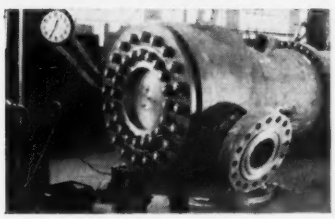




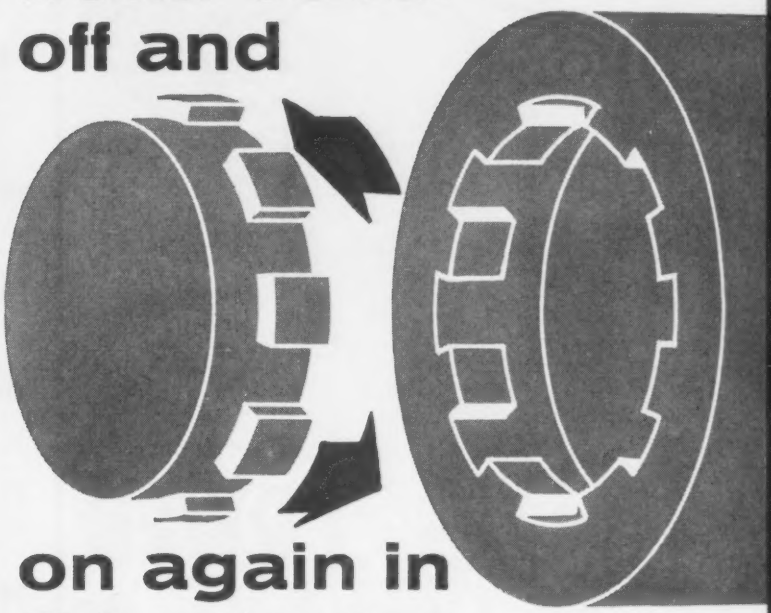








# head cover off and



# on again in 84 minutes

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Periodic internal inspection of high pressure feedwater heaters is easy and fast with G-R Type "L" breech block heads. The complete operation of cover removal and reinstallation is shown in photographs at left.

When the cover is removed the entire tube sheet and all tube joints are readily accessible for examination and cleaning from outside the heater. No need to squeeze and squirm inside the water head whether heaters are large or small.

G-R Type "L" breech block high pressure heaters are available with all welded seals without gaskets, with rolled or rolled-and-welded tube joints.

More than 1,000 G-R heaters are installed operating at over 1,000 psi. More than 250 are in operation at pressures in excess of 3,000 psi. *This record is unsurpassed by any other American manufacturer.*

G-R high pressure heaters are available in all types and sizes, horizontal or vertical, and are furnished with suitable cover handling rigs.

Take advantage of G-R's extensive experience in the design and fabrication of Feedwater Heaters. There is a G-R representative in your territory ready to help you.

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For more facts circle 883 on Reader Service card, p 197

# Here's POWER to clean tubes from 1/2" to 2" QUICKLY

Rotojet Junior Tube Cleaners are unusually powerful for their size and weight. They are fed easily through the tubes with the operating hose, and can be shifted quickly from tube to tube. Their convenient size, speed, and ease of operation offer a marked contrast with external cleaners costing many times more.

An air valve directly behind the Rotojet motor permits one-man operation. Very little headroom is required, and either vertical or horizontal tubes can be cleaned.

Simplicity of Rotojet design and precision construction assure long service, efficient use of power, and freedom from trouble. Economical brushes, cutters, and scrapers meet practically any requirement.

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Expanding scraper and replaceable element.

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Air valve for one-man operation.

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*Tube Cleaner Specialists Since 1910*
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## Instrumentation

pressure, vacuum and compound gages. Helicoid Gage Div, American Chain & Cable Company, Inc

**282** **Rotameters** and tube and float meters are described in 20-p bulletin 520.100. Capacities range from 0.25 to 310 gpm of water, 1.1 to 1300 scfm of air. Wallace & Tiernan Inc

**283** **Pyrometers** to measure flames and hot gases above 3000 F are topics of bulletins 0054 and 0054.1. Atlantic Pyrometers, Inc

**284** **Flowmeter kits** are subject of 4-p pamphlet 10A1010. One kit is available with fully enclosed meter. Fischer & Porter Co

**285** **Potentiometers** ranging from ½- to 5-in. dia are detailed in 28-p catalog from DeJur-Amsco Corporation, Electronic Sales Div

**286** **Stainless-steel 1½-in. meter** for corrosive and noncorrosive liquids is topic of 4-p circular. Neptune Meter Company

**287** **Portable potentiometer indicator** is discussed in revised 4-p brochure 64-1. Highlights specifications, applications and accessories. Thermo Electric Co, Inc

**288** **Potentiometer** with new rebalancing element is subject of 24-p catalog. Modular construction is illustrated with specs on three basic models: strip- and circular-chart recorders, circular-scale indicator. Minneapolis - Honeywell Regulator Company

**289** **Tachometers,** 19 types, are topic of 12-p bulletin 62. Drawings show shafts, drives, drive arrangements. Jones Motrola Corp

**290** **Alarm rotameters,** magnetic and electronic, measure fluid flow rates and warn of abnormal rates. Details are in 4-p bulletin 18A. Schutte and Koerting Co

**291** **Pressure-measuring instrument,** tested to 2000 psi, serves as a low-pressure dead-weight gage or a high-range differential-pressure manometer. 4-p folder is offered by ToPaz Inc

**292** **Operation recorders** are topic of bulletin describing and illustrating applications. The Esterline-Angus Company

**293** **Portable pyrometer indicator** is topic of bulletin 0036. Gives performance specs and standard calibrations for use with pyrometer. Atlantic Pyrometer, Inc

**294** **Pressure instruments,** firm's complete line, are covered in revised catalog 40. Bailey Meter Company

**295** **Ac pressure instruments** are explained with electrical and me-

Begins on page 204

chanical specs and dimensions in bulletin S-606. Servonic Instruments, Inc

**296** **Instruments for measuring,** indicating, recording and controlling pressure and vacuum are subject of 32-p catalog C70-1a. Minneapolis - Honeywell Regulator Company

**297** **Multipoint controllers,** 10-point, off-on potentiometer or bridge, are illustrated in 8-p catalog 52. Specs cover their use with standard sensing elements. Thermo Electric Co, Inc

**298** **Temperature-control systems** are topic of 8-p catalog F-8031-1. Components of graphic-panel and identification control centers are described. Barber-Colman Co

**299** **Photoelectric control unit** is a combination of electronic timer and photoelectric scanner with ranges from 2 in. to 18 ft—described in circular PE-7. Farmer Electric Products Company, Inc

**300** **Packaged control panels** for pumps, materials-handling and air-conditioning equipment are featured in 8-p bulletin GEA-6334A. Photos show panel components—starters, relays, switches, timers. General Electric Co

**301** **"Temperature recording** from platinum resistance sensors" is title of 12-p booklet. Combination amplifier-sensor records −320 to +2000 F. Brush Instruments Div, Clevite Corp

**302** **Chart and ink** 28-p catalog G-100-6 describes features of paper and ink used, lists most common charts. Minneapolis - Honeywell Regulator Company

**303** **Recorder-indicator** catalog C 15-1a has 48 pp. Well-illustrated catalog shows new design features, gives tables and charts. Minneapolis-Honeywell Regulator Co

**304** **Pressure regulator** for laboratory test applications is described in bulletin 113. Regulator has inlet pressures up to 1 psi and outlet pressures from 3.2- to 16-in. $H_2O$. American Meter Company

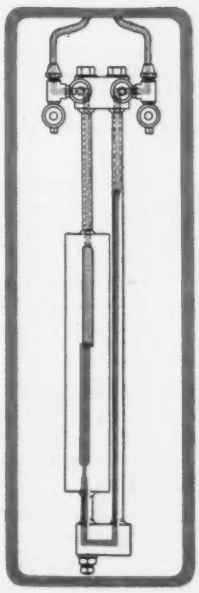
**305** **Control-linkage** systems are topic of 12-p revised bulletin P81-5. Drive and driven levers are charted and connecting links, bearings and shafts and cable connectors are discussed. Bailey Meter Company

**306** **Metal-sheathed thermocouple** catalog TT-317 lists components and typical assemblies of miniature models. Trinity Equipment Corp

**307** **Temperature probes** are topic of 8-p booklet 66030. Rosemount Engineering Company


# This green liquid column could be your boiler water level –

## a true check on your boiler's safety by the Reliance EYE-HYE



Easy to read, like the conventional boiler gage, the illuminated green fluid gives you even sharper indication of where water levels stand. EYE-HYE can be placed at any vantage point, on panel, post or wall. Manometric operating principle insures perfect measurement, sensitive to slightest level changes.

Easy to install, easy to maintain. With no mechanical working parts to fail – no gears, magnets, diaphragms or linkage – it's simple, fool-proof. No adjustments. Each EYE-HYE is factory-calibrated to *your* water level range and working steam pressure.

Various EYE-HYE models fit any remote gage need – for boilers, tanks, storage vessels – any visibility length, any working pressure. Wide vision facility makes reading visible from wide area . . . For safe, sure check on boiler water levels, write the factory for full EYE-HYE information.

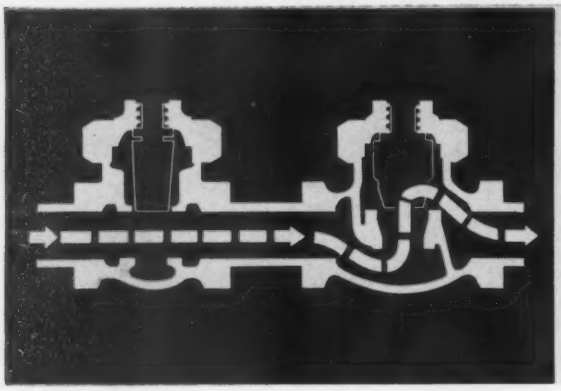
**The Reliance Gauge Column Co. • 5902 Carnegie Ave., Cleveland 3, Ohio**

Reliance® BOILER SAFETY DEVICES




For more facts circle 885 on Reader Service card, p 197

# GENERAL EQUIPMENT: VALVES, PIPING, FITTINGS, SPECIALTIES



Piping-system services get more severe each year—pressures and temperatures are on the rise and new liquids to be handled present new corrosion problems. But valve and piping technology is keeping up; new liner materials are available to combat corrosion at higher temperatures. Availability in larger and larger sizes is the rule now for all-plastic fittings.

V. W. Edwards

Associate Editor

## Valve equipment designs

**46** **Multiple valve positioner** acts like control-selector-switch signal. Use to automatically position valves, float levels, doors, etc. By turning or pressing the selector control switch in pipeline control offices, you can open or close a valve at several selected positions which may be miles away. Return-readout-signal light indicates when the predetermined position of the pipeline valve is reached.—Hanna Engineering Works

**47** **Air-powered valve operators** extend range of sizes — formerly available only for large-size valves, they can now be used on 8-in. and larger 900-lb valves, 8-in. and larger 1500-lb valves, 6-in. and larger 2500-lb valves. According to maker, operator cuts manpower five to one: it lets one man operate high-pressure valves quickly and easily. Unit is a ring gear and pinion assembly fastened to handwheel and valve yoke. Portable air motor and plant 90-psi compressed air turn pinion gear and hand-wheel through standard wrench. —Edward Valves, Inc

**48** **Valve positioner** works with diaphragm- or piston-operated control valves and all types of pneumatic drives. It can produce full valve travel in less than two sec. Pilot's long-stroke valve proportions for steady-state stability. A feedback rebalances the positioner to jibe with changing load.—Copes-Vulcan Div, Blaw-Knox Company

**49** **Miniature ball valve** is versatile, easy to repair. It's suited to critical control of fluid flow — valve handle rotates with little effort and ball is fully supported by Teflon seat rings. Valve can replace faucets, pet and bib cocks, plug and needle valves for rapid and leak-free operation regardless of pressure and periods of idleness. Union-nut end connection lets you remove body from line without disturbing piping.—Valve & Fittings Div, Cooper Alloy Corporation

**50** **Ball valve is fast** and easy to operate — rated at 300 lb for water, oil or gas service at 250 F, it comes in ½- to 2-in. sizes. Just a quick quarter turn of handle opens or closes it. Ball's wiping action across seats forces out foreign matter, prevents abrasive wear which causes leakage. O-ring-stem seals assure leak-proof stuffing box.—R-P&C Valve Div of American Chain & Cable Co, Inc

**51** **Fire-protection valve** cuts off flow of flammable liquid to fire areas. Design is simple, using no counterweights or interior bellows: stainless-steel bolted-bonnet gate valve is held open against two stainless springs by a fusible link. When heat hits a preset point, the link melts and springs snap the valve shut.—Valve & Fittings Div, Cooper Alloy Corp

**52** **Water-tempering valves** are designed for large hot-water supply systems. Series 170 features bronze bodies, streamlined waterways and high capacity. The 1-in. size passes 31 gpm with a 10-lb pressure drop; the 1½-incher passes 44 gpm. Thermostatic elements interchange in all five sizes, to cut your spare-parts inventory.—Watts Regulator Company

**53** **Globe-valve redesign** promises closer throttling control and an end to disk vibration and chatter. These valves feature a nonrotating stem with nonrising handwheel and fixed disk. Galling between stem foot and disk is eliminated and, since the stem doesn't turn in its packing, there's no chance for it to spiral through and cause excess leakage. So far, the new design is available in firm's 150-lb globe, angle and Y valves, in 2-in. sizes and up.—Alloy Steel Products Co

**54** **Plastic-lined metal Y valves** in sizes from 1 to 3 in. are designed to control corrosive fluids. Inside of body and bonnet, stuffing box and stem are protected by a heavy lining — one of three different plastics, depending on service. — Wm Powell Company

**55** **Self-draining valve** fits in where you want the valve seat inside the pipe or vessel wall. No liquid remains between liquid container and seat when valve is closed. Threaded part of stem is outside the valve body — it's not affected by temperature of the liquid. Stem goes to or from the seat in a straight line, giving good seating every time. — Jerguson Gage & Valve Co

**56** **Quick and easy installation** is this valve's feature. Built-in union ends let you get the job done in just

two steps: (1) screw or weld union ends to pipe ends (2) assemble 1-piece forged body to union nut. Valve disassembles equally fast for maintenance. Materials: stainless, carbon steel or brass. — Clayton Mark & Co

**57** **Valve operates in hazardous locations,** controls highly abrasive slurries and corrosive materials in inaccessible locations. Anything that flows through pipe will flow through valve's pipelike body, maker claims.—Farris Flexible Valve Corp

**58** **Cartridge check valve** is easy to install in any pneumatic or hydraulic system. Designed to be placed in single bored hole, it avoids bulky complicated piping arrangements. Nonleaking C-200 comes in steel or aluminum in sizes from ⅛ to ¾ in., operates at pressures to 5000 psi.—Circle Seal Products Co, Inc

**59** **Disassembly on line** is the talking point here. A tapered cartridge with bottom entry contains entire seating assembly, can be removed easily without taking valve body off the line. In bronze, steel or 316-stainless construction, valve is rated from vacuum to 800 psi, –40 to +400 F.—Crane Company

**60** **Relief valve** works from 850 to 7200 psi. It's externally referenced for use as a priority or sequence valve—operates from –40 to +200 F, provides dead-tight sealing to above 95% of preset cracking pressure. There's almost no pressure rise with increasing flow—design permits system backpressure on poppet to increase its life, give good flow characteristics.—Circle Seal Products Co, Inc

**61** **Shutoff valve** handles liquid or gas at 6000 psi. Made of stainless steel with Teflon seals, series 920-T valve withstands severe corrosive conditions. Internal design has Teflon packers for dead-tight seal. A floating sleeve rises to protect packers from flow when valve is open. Seals can be replaced with valve on-line. Double-tapered stem design throttles gradually with valve closed.—Circle Seal Products Co, Inc

**62** **Compact bar-stock valves** with NPT or AND threaded ends are rated 600 WOG, 1000-psi test. Materials of construction are carbon steel, 303 and 316 stainless or brass. Self-lapping and -cleaning action promises good sealing, long life. Prices start at $10.20 for the carbon-steel ¼-incher.—Hydromatics, Inc

## • Valve design aids:

Circle key numbers on Reader Service card, page 197, for your free copies

**308** **Determining flow characteristics** of manufacturer's valves is covered in revised 20-p bulletin V-602. Pressure drops for plug and venturi valves are charted. Rockwell Manufacturing Company, Nordstrom Valve Div

**309** **Semisteel valves** and accessories are illustrated in revised 44-p bulletin V-203. Details steam-jacketed and multiport valves. Rockwell Manufacturing Company, Nordstrom Valve Div

**310** **Corrosion-resistant valves** are illustrated in 16-p bulletin 7. Alloy materials, chemical composition, ranges are listed. Alloy Steel Products Company

**311** **Valve catalog** contains all ordering information—cross-reference charts, weight tables. 20-p catalog 800 A is available from American-Standard Controls Div

**312** **Standard, low-pressure valves**—gate, globe, angle and check—are subject of 16-p pocket booklet 1496-V. Comparison chart, application and installation info are features. Ohio Brass Co

**313** **Bronze, iron-body** and cast-steel gate, globe, angle and check valves are featured in 16-p catalog 10-B. R-P&C Valve Div, American Chain & Cable Co, Inc

**314** **Valve servicing** and lubrication are shown step-by-step in 8-p catalog V-218 Rev 2. Chart of recommended lubes is included. Rockwell Manufacturing Co

**315** **Expansion** and solenoid valves, strainers, liquid level and pilot controls are chapters of 16-p catalog 58. Sporlan Valve Company

**316** **Hydraulic valve actuator** locks automatically, holds gate or plug in any position, has motor and pump which run only for valve opening and closing. Details are in bulletin VA-10. Oil-Dyne, Inc

**317** **Liquid-level-gage valves** are union and screwed bonnet for leakproof service. 4-p folders 397 and 398 include drawings and tables of features. Jerguson Gage & Valve Co

**318** **Recording type controllers** operate diaphragm motor valves for controlling steam or liquid flow. They're subject of 4-p circular 335. Stickle Steam Specialties Co

**319** **Actuators,** spring and diaphragm, are shown in different valve assemblies in 4-p bulletin B-1020-7. Conoflow Corp

**320** **Electric** and mechanical positioners are used on devices regulating valves, throttles, machine tools such as air-hydraulic power cylinders and motorized screw drives. See bulletin 500A issued by Hanna Engineering Works

**321** **Automatic motorized** zone-control and backpressure - relief valves are topic of 12-p booklet from A W Cash Valve Mfg Co

**322** **Diaphragm motor valves** are described in bulletins 133 and 137. Tables show spring ranges, chamber sizes and valve-orifice constants and dimensions. American Meter Company

**323** **Ball valves** in combinations of metals, seats and seals from ¼ to 2½ in. and for pressures up to 400 lb are detailed in 8-p section 5 of reference book 39. Homestead Valve Mfg Co

**324** **Valves for water, oil,** gas, steam, air and corrosive service: featured in 24-p brochure. Discusses bronze, iron, steel and corrosion-resistant valves. The Wm Powell Company

**325** **Valve control-unit** wiring is diagramed in 8-p bulletin 8401. Chapters deal with troubleshooting, lube. Hupp Aviation Div, Hupp Corp

**326** **Cast and forged-steel valves,** ¼ to 18 in., 300- to 4500-lb pressures, are detailed in 91-p catalog 14. Includes ASA dimensions and pressure-temperature ratings and ASTM basic materials specifications. Curves and formulas help you correlate valve size and pressure drop. Edward Valves, Inc

**327** **Pressure-reducing valve** is topic of catalog 5890. Design data is included on capacities, service. C E Squires Campany

**328** **Gate valves** large and small, designed specifically for ductile iron, are described in brochure 1011. 12 pp list specifications, pressure - temperature ratings and applications. The Ohio Injector Co

continued

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Now you can take the sting out of cooling-water contaminants, solve treatment problems with chlorinators and pumps by Wallace & Tiernan.

For biological control there's intermittent desliming.

W&T chlorination kills slime and spores, never lets growth affect heat-exchange capacity. Job-proportioned V-notch Chlorinators feed up to 8,000 lbs. of chlorine per day. Treatment is efficient and economical. You get reliable control. Heat-exchange surfaces stay slime-free.

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The Wallace & Tiernan Series 100 Pump feeds chromates or acids at rates of up to 50 gph or boiler-treatment chemicals against pressures up to 1200 psi. The pump's unitized construction means lifelong accuracy, reduced maintenance. Choose one or two liquid ends, with individual stroke adjustment, to double capacity or feed two chemicals simultaneously. Where high pressures are not a problem, W&T Diaphragm Pumps also give reliable feeding of 1 to 500 gpd. Heat-exchange surfaces stay corrosion-free.

With Wallace & Tiernan Chlorinators and Pumps you keep condenser tubes clean and sound, assure heat-exchange efficiency.

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25 MAIN STREET, BELLEVILLE 9, NEW JERSEY


## Valves

*Begins on page 216*

**329** **Bonnetless knife-gate valve** for use on fibrous and slurry lines and corrosive services is topic of 4-p circular 301. DeZurik Corp

**330** **H-p h-t cast-steel** gate and globe valves with reduced operating torque and positive shutoff are explained in 6-p bulletin. Walworth Company

**331** **Cast-steel lubricated-plug valves** use ball-bearing system to handle high-pressure line thrust. 16-p booklet features size and rating tables. Walworth Company

**332** **Screwed-end plug valves** for instrument and process piping are diagramed in 4-p brochure D-1. Valves provide bubbletight closure, corrosion resistance. Continental Manufacturing Co

**333** **Check-valve** bulletin shows how to silence piping systems, eliminate water hammer. Combination Pump Valve Company

**334** **Check valve has simplified design** —subject of 4-p folder 672-60-5M. Dominion Engineering Co, Ltd

**335** **Free-discharge valve** for under 200-ft head is announced in 16-p well-illustrated bulletin O2B9206. Allis-Chalmers Mfg Company

**336** **Explosive valves** with reusable bodies, rated up to 5000 psi, are subject of 4-p bulletin 1160 XV. Conax Corp

**337** **Pinch valves,** manual, electric and hydraulic, are subject of 11-p catalog 609. Mine and Smelter Supply Co, Mfg Div

**338** **Solenoid valve** selector chart SL-1 gives size, pressure, temperature and assemblies in its 4 pp. J D Gould Company

**339** **Pressure regulators**—direct acting, reverse acting and control valves—are topics of 12-p bulletin 116. Flow coefficients for sizing water and steam valves are included. Manning, Maxwell & Moore, Inc

**340** **Sliding-gate** and plate temperature regulators for steam, water, air or gas are described in 8-p catalog J180-1. OPW-Jordan

**341** **Pressure regulator** with a 0.5- to 125-psi control range for steam, water, air, oil or gas service is subject of 8-p brochure J160-1 and spec sheet PNB5-61. OPW-Jordan

**342** **Air-control valves,** mechanically and manually operated, are charted in bulletin 60-1. Hoffman Valves, Inc

**343** **Sizing sliding-gate regulators** and control valves is shown in 4-p chart-bulletin JSC-1 from OPW-Jordan

## ● Piping designs:

**Just circle key numbers on Reader Service card, p 197, for complete details**

**63** **New technique** in applying jacketed pipe insulation allows job-site fabrication of aluminum-covered elbows, turns, sweeps and bends directly from straight lengths. Preformed bands, available for pipe sizes from ¾ to 24 in., let you jacket a fitting in only a few steps, using a straight length of insulation, a saw, a band and a banding wrench.—Johns-Manville

**64** **Self-locking jacketing** lets you aluminum-sheath insulated lines without special tools, with less effort. One man can install this jacketing, even on overhead lines. It's precut and prerolled. Natural tension of the rolled sections holds jacketing in place until it's fastened.—Premetco

**65** **Metal hose** has high pressure rating, flexibility. It comes in sizes from ¼ to 1¼ in. helically convoluted, braided or unbraided. Single longitudinal weld and smooth helical convolutions provide for easy cleaning to high levels of purity for cryogenic and sensitive applications. One suggested application is utility piping. Working pressures in the ¼-in. size run as high as 4500 psi with static band radius of 1.03 in.—Flexonics Corporation

**66** **Spiral-wrap hose** works up to 3000 psi. Diameters run 1¼ to 2 in. Inner tube alternates layers of spiral-wire wrapping and synthetic rubber. Segmented fittings, leak- and blowoff-proof, assemble quickly with hand tools. —Aeroquip Corp

**67** **Hose handles steam** under pressure, resists temperatures to 300 F, pressures to 125 psi. Neoprene jacket makes it tough, yet flexible and crimp-resistant. Teflon inner tube has low friction coefficient and is inert to corrosive materials. The hose is easily cut to desired lengths, may be used with standard tube fittings. Sizes: from ¼- to ½-in. ID. — W S Shamban & Co

**68** **General-purpose hose clamp** has no perforations through the band to cause rubber extrusion or


# COUNT ON THE NEW W&T SERIES 100 PUMP WHEN YOU NEED...

## ...ACCURATE METERING WITH SMOOTH CONTROL

Wallace & Tiernan's newest plunger pump delivers 3.2 gph vs 1200 psi to 50 gph vs 100 psi, repeatable within ± 1%. Easy adjustment over 10:1 range with the pump running.

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For more facts circle 887 on Reader Service card, p 197

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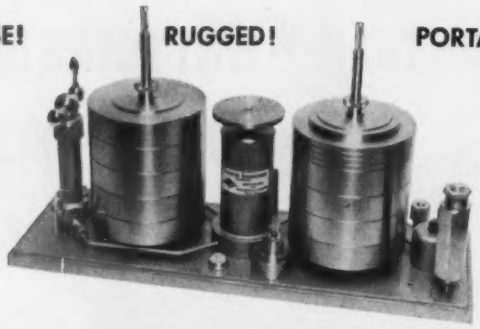

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For use where accurate pressure measurements are required, including turbine testing in power generation plants. Tester has a self contained pump to generate pressure. You can check spring gauges, calibrate other instruments or pressure-test small vessels. Metric calibration optional. Available with varying pressure ranges to 10,000 p.s.i. and pressure intervals of 1/10 or 1 p.s.i. Comes with metal carrying case. Metal base mounts on tripod for field use.

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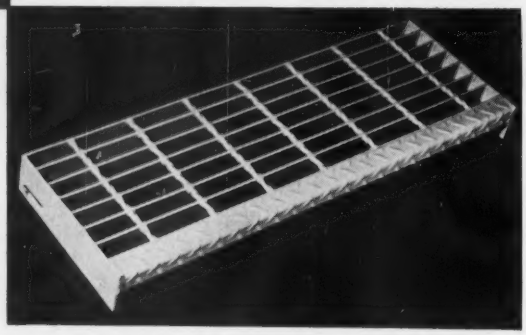
*with* **Strong, Light-Weight, Self-Cleaning**



**KERRIGAN Weldforged STAIR TREADS**

Kerrigan's standard tread with Super-Diamond Nosing (illustrated) gives maximum visibility and underfoot safety where needed most.
Increase plant safety with these easily installed treads.
Send now for new, easy-to-use steel grating and tread catalogs.

KERRIGAN IRON WORKS COMPANY Nashville, Tennessee

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**For more facts circle 889 on Reader Service card, p 197**

## Valves, piping

Begins on page 216

scuffing. Steel screw engages on coined threads. Clamp is easily removed if required, but won't snap open or jog loose. You can adjust diameter for many applications. — Aeroquip Corp, Marman Div

## • Piping design aids

**Just circle key numbers on the Reader Service card, page 197, to get complete product story**

**344** **Silicate insulations** for pipe and block are covered with heat-transmission data, physical and thermal characteristics listed. Details in 6-p booklet 6472. Philip Carey Mfg Company

**345** **Plastic-pipe insulation** is discussed in 4-p pamphlet. Temperature limitations, thermal efficiencies, fire ratings and packaging data are given. Gustin-Bacon Mfg Company

**346** **Introduction** to new manufacturer of pipe, pipe fittings, sheet in PVC, polyethylene and ABS fabrications is given in 8-p catalog. Trans-Plastics Corporation

**347** **Computer service** for piping flexibility — introduced in booklet from The Service Bureau Corp

**348** **"How to measure** and relate pipe, tubing and hose sizes" is title of 16-p booklet 631 which supplies standard methods of measurement. Aeroquip Corporation

**349** **Thawing pipe** with 1-v electricity: subject of bulletin EW-243. Contains instructions, lists equipment. Hobart Brothers Company

**350** **Pipe-fitters' manual** is comprehensive 72-p guide. Text, tables and illustrations give mathematical, physical, chemical, metallurgical data at a glance. Tube Turns Div of Chemetron Corp

**351** **Transite pressure-pipe** installation guide TR-62A covers handling and installing pipe in its 124 pp—site conditions are also included. Johns-Manville Corp

**352** **Flexible rubber pipe,** expansion joints, transmission and conveyor belts are subject of catalog M5. 24 pp include specs and ordering info. Raybestos-Manhattan, Inc, Manhattan Rubber Div

**353** **Pipe and straight-thread adapters** for tubing-system connections are illustrated in 16-p booklet 4360. Parker Fittings & Hose Div, Parker-Hannifin Corp

continued

IN PENNSYLVANIA COMPRESSORS

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**Pennsylvania Compressors run efficiently, quietly, with minimum maintenance . . . here's why.**

Pennsylvania AERTYTE Disk Valves have no nuts, bolts, or screws to break or burn fast. You get longer valve life . . . reduced wear . . . quiet operation. Flat valve discs have no flexing or bending action to weaken or distort them; they remain perfectly flat and tightly seated over long periods of service.

But this is only part of the Pennsylvania story. Learn more about the dependability of Pennsylvania compressors in our booklet, "Compressors For Industry." It describes Pennsylvania Compressors from 10 to 350 hp, horizontal, vertical, angle, and OILFRE models. Write to Dept. C-9 for your copy today.

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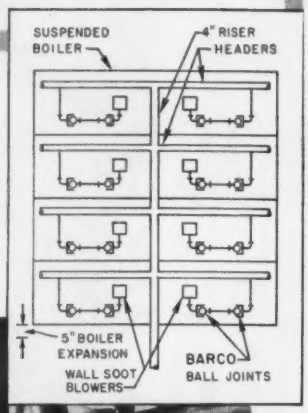
**For more facts circle 890 on Reader Service card, p 197**

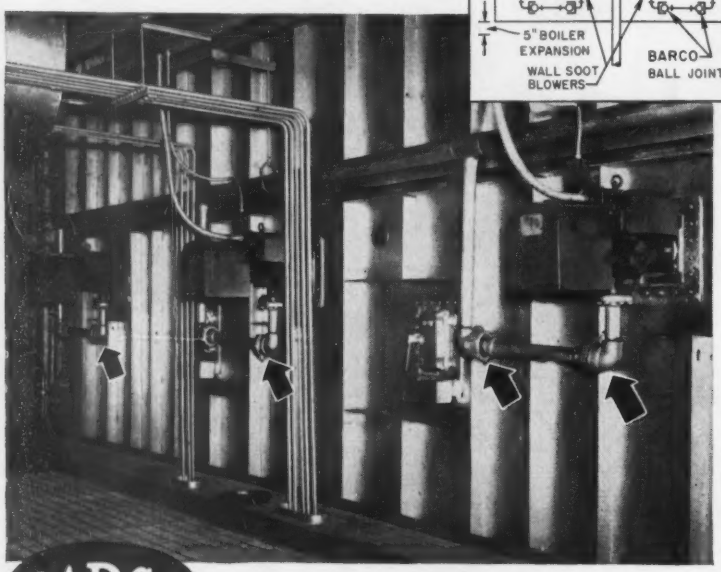
# Better Flexible Connections for SOOT BLOWERS




**IN PENNSYLVANIA—**

(See diagram and photo) This suspended steam generator moves downward 5" or more between "cold" and "hot" positions. Barco Ball Joints on lines to the soot blowers easily allow movement and eliminate twisting stresses. Service: 300 psi air, ambient temperature (also suitable for steam). Three years experience with 62 joints installed here shows no maintenance required.

*(Photo: Pennsylvania Power Co., New Castle, Pa. Consulting Engineer: Commonwealth Associates Inc., Jackson, Mich.)*



BARCO **BALL JOINTS**

## SAVE PIPE – 30° FLEX!

Many Barco Ball Joints are now going into soot blower piping connections. Here's why:

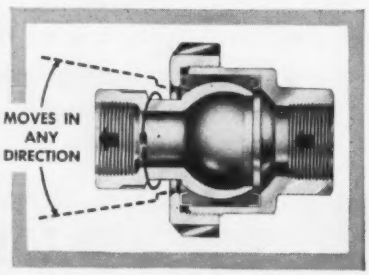
**MORE FLEX! SHORTER PIPE!** Instead of allowing only ½" flex per foot of pipe, Barco provides up to 6".

**PRESSURE-SAFE**—No danger of blow-outs. Joints contain no material that gets "tired" or deteriorates. Safe for alternate use with high temperature steam.

**SAVE TIME**—Piping design simplified. Easy to solve complex pipe movement problems with minimum engineering time.

**NO MAINTENANCE NUISANCE**—Joints work without attention or inspection. No lubrication. No periodic replacement. Always "self-aligning".

Besides use on Soot Blowers, Barco Ball Joints in power plants are now finding application on steam exhaust relief lines, feedwater connections, acid cleaning lines, gas lines, pump connections, and expansion loops. They provide many advantages: FIRE-SAFE and virtually indestructible; easy to engineer — develop no "end thrust", don't require anchoring. Sizes and styles for every purpose; threaded, flanged, or welding ends. *Ask for complete information.* SEND FOR CATALOG 250.




**BARCO MANUFACTURING CO.**

5221 Hough St., Barrington, Illinois

In Canada: The Holden Co., Ltd., Montreal


## Valves, piping

**354** **Plastic pipe** is feature of 10-p brochure TR-270A — working pressures, flow chart and table of properties given. One chapter explains cutting, connecting and installing. Johns-Manville Corp

**355** **Transite pipes** for plant fire-protection systems are asbestos cement; detailed in 8-p booklet TR-253A. Johns-Manville Corp

**356** **Ductile-iron pipe** is covered in well-illustrated 22-p brochure. Properties and specs are given. James B Clow & Sons, Inc

**357** **Chrome-alloy pipe,** tubing, fittings and forgings are covered in bulletin available from Capitol Pipe and Steel Products, Inc

**358** **Asbestos - cement** water - pipe products are described in 10-p brochure TR-254A. Design data, details of application on cooling-water supply and distribution lines are included. Johns-Manville Corp

**359** **Pipe OD and wall thickness** from ½ to 42 in. are shown on chart, which relates ASA Standard information and schedule numbers. Midwest Piping Div, Crane Co

**360** **Rubber pipe,** wire-reinforced to dampen vibration, is feature of 4-p bulletin 866. General Rubber Corporation

**361** **Mounting tubing,** wiring, new techniques are featured in 76-p manual 212 G. Firm's clamps, brackets, shims and line supports are shown. TA Mfg Co

**362** **Fabricated** or semifabricated welded-steel tubing comes in five different steels—shown in 4-p folder 6759. Armco Steel Corp

**363** **Welded-steel tubing** and solid bars, weight-comparison tables are featured in 4-p bulletin. The Standard Tube Company

**364** **Expanded teflon tubing** recovers its original dimensions when heated to fit snugly over parts or tubing in electrical, chemical or mechanical applications. Bulletin 3E tells story. Pennsylvania Fluorocarbon Co, Inc

**365** **Weight computations** for welded steel tubing are made easy with tables available from Jones & Laughlin Steel Corp

**366** **Flexible hoses and ducts** for moving air, dust, fumes and materials are described in 12-p bulletin 605. Covers selection, installation. The Flexaust Company

**367** **Flexible hoses** for conveying gases, solids and fluids are described in 20-p catalog ID-100D. Specs, applications, coupling rec-

Begins on page 216

ommendations are included. Universal Metal Hose Company

**368** **Teflon h-p** hose in a -16 size is rated at 3000 psi for —65 to +400 F. 8-p brochure is available from Resistoflex Corporation

**369** **Aluminum jacketing** for insulation protection is detailed in 4-p bulletin ICB. Insul-Coustic Corp

## ● Fittings and specialties

### Circle key numbers on p 197 for all the details

**69** **Injection-molded tees** made of 8-in. unplasticized PVC are now available. Standard-weight tees withstand higher pressure, cost less than the fabricated variety, says maker. Recommended working pressure: 75 psi.—Tube Turns Plastics, Inc

**70** **Bellows expansion joints,** rigid against all but axial movement, are externally or internally guided. When internal, guide ring welded to inner slip rides along machined bore of the body. Surfaces are finished to close tolerances, holding friction to a minimum and cutting danger of pipe strain. — Adsco Div, Yuba Consolidated Industries, Inc

**71** **Expansion compensators** to tackle corrosive service are made entirely of corrosion-resistant stainless steel. They're designed to absorb thermal growth in pipes from ¾ to 3 in. Screwed, welded or flanged ends, heavy-duty bellows, antitorque mechanism and protective shroud work at pressures up to 175 psi, temperatures as high as 750 F. Compensator is also available in bronze, to use where dissimilar metals might present corrosion problems. Here working pressures run to 150 psi, temperatures to 406 F.—Flexonics Corporation

**72** **Snubber tube fitting** filters, gives dampening effect, prevents sudden flow surges from damaging costly equipment. You can use it to filter liquids and gases, espe-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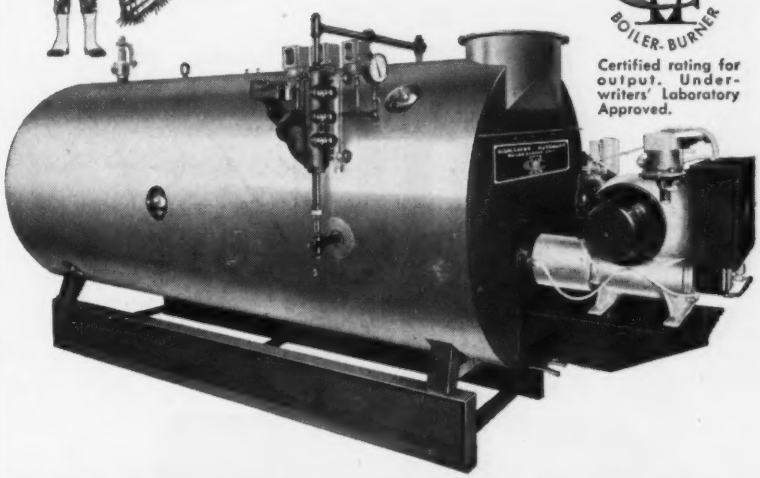
## COMPLETELY AUTOMATIC BOILER-BURNER UNIT

HIGHLANDER BOILER-BURNER

Certified rating for output. Underwriters' Laboratory Approved.



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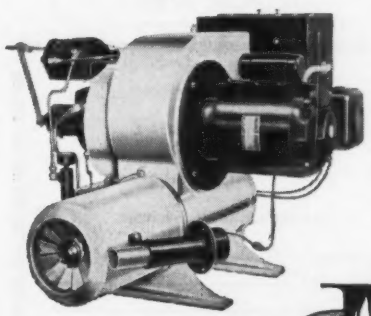

HEART OF THE HIGHLANDER is the famous Industrial Combustion Burner. The HEV-E-OIL Burner engineered to use inexpensive No. 4, 5 and 6 heavy oils is shown here. Available from 5 to 150 gph. HEV-E-DUTY Power Gas Burners and Combination gas/oil Burners from 720,000 to 21,000,000 BTU.

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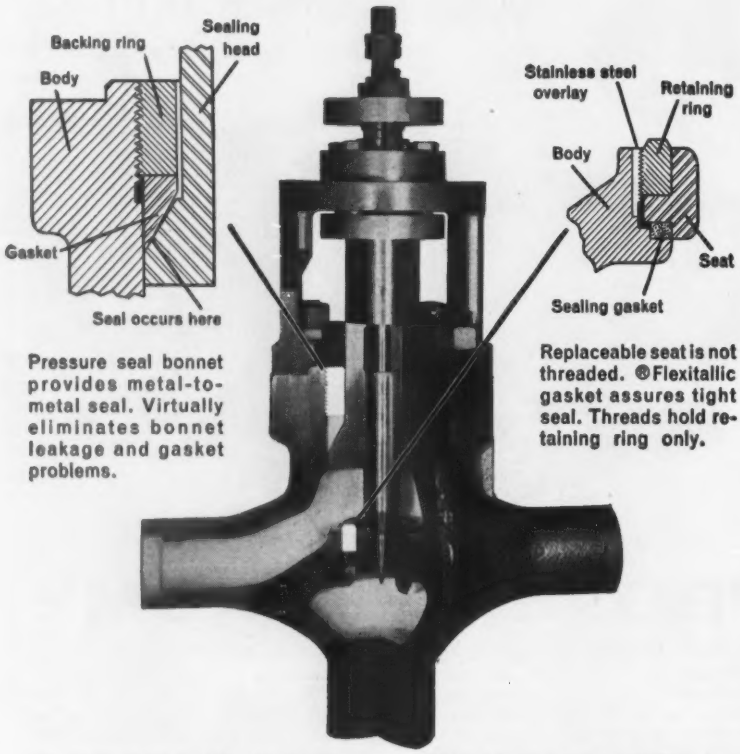
ROCKWELL-REPUBLIC

*High pressure globe valve withstands pressure drops up to body ratings*




Pressure seal bonnet provides metal-to-metal seal. Virtually eliminates bonnet leakage and gasket problems.

Replaceable seat is not threaded. ®Flexitallic gasket assures tight seal. Threads hold retaining ring only.

Rockwell-Republic high pressure globe valves are available in 1½", 2", and 3" sizes for 1500, 2500 and 4500 psi standards. In addition to removable seat and pressure seal bonnet, these valves are available with bolted bonnets and quick-change trim. For more information about this and other Rockwell-Republic components and systems, just mail the coupon below. RF-23

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**Republic Flow Meters Co.** *(Subsidiary of Rockwell Manufacturing Company)*
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cially in low-flow lines—pressure-gage lines, for example.—Crawford Fitting Company

**73** **O-ring seal type fittings** promise leakproof service at 6000 psi with water, oil or gas. Unions need only hand tightening for good performance at temperatures from –20 to +275 F. Sizes: ¼ to 2½ in.—Kahn & Co, Inc

**74** **Socket-welded tube fittings** are available in aluminum, brass, Inconel, nickel, stainless steel and steel. Standard line comes in sizes from ⅛- to 1-in. OD. Custom shapes, sizes and materials can be made up to your specs. Fittings are designed to tackle problems of corrosion, pressure and temperature, turn in a leakproof performance even under vibration and shock conditions.—Cajon Machine Company

**75** **Fitting for small-diameter pipe** withstands extreme low or high temperatures and high pressures or vacuum where leakproof sealing is a requirement. You can apply this stainless-steel fitting from –450 to +1500 F, or at pressures to 16,000 psig on critical pneumatic, hydraulic, fuel, cooling, heat-transfer and pressure or vacuum lines.—Aeroquip Corp, Marman Div

**76** **Four low-cost basket strainers** can go in steam, air, oil, gas or chemical lines. They'll catch dirt, foreign matter and pipe cuttings in most suction, high- or low-pressure installations. Units come in semisteel or cast steel with clamped or bolted covers. Sizes: 2 to 16 in.—Strong

### • Fittings and specialties: Design aids

Just circle key numbers on the Reader Service card, page 197, to get complete product story

**369** **Steam trap,** thermostatic modulating type, is discussed in catalog 5020. Feature is continuous flow modulation. C E Squires Company

**370** **Ductile fittings** and valves are described in 12-p catalog with designs, weights and comparison

# Replace Complete Trim Without Removing Valve From Line!

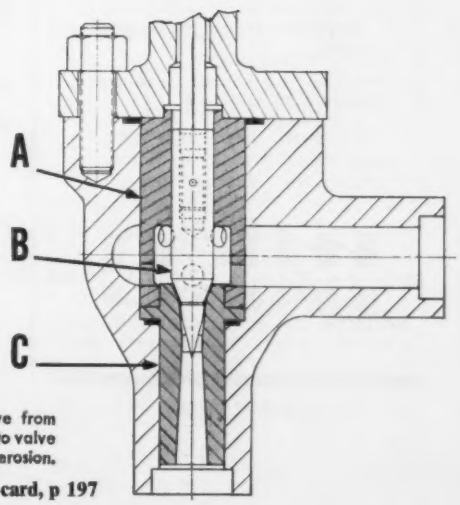
*Rockwell-built Republic V-10 valves with Quick-change Trim save many hours of downtime on severe energy conversion applications with pressure drops up to 3500 lbs.*

The Republic V-10 angle valve for high-pressure liquid or steam regulating services offers unique valve maintenance advantages because of its Quick-change Trim construction.

**Quick-change Trim** in the V-10 valve makes it possible for you to replace the valve seat, inner valve and guide in little more time than is required to dismantle and reassemble a bolted joint. No time is required for lapping the seating surfaces of the valve, since this is done in advance. *And you can make this quick trim change in minutes without removing valve from the line.* The savings to you are considerable in downtime and maintenance expense.

**Republic V-10 Valves** are available with either welded seat or replaceable seat, in addition to the Quick-change Trim design, with bolted or pressure seal bonnets. V-10 valve contours are designed to produce not only the desired regulating characteristics, but also to reduce erosion damage and noise as well. Precise manufacture and long-life materials make Republic regulating valves perform better, last longer, with less maintenance. For additional information, contact your nearest Republic Representative, or write to Republic Flow Meters Company, 2240 Diversey Parkway, Chicago 47, Illinois. In Canada: Republic Flow Meters Canada, Ltd., Toronto. Subsidiary of Rockwell Manufacturing Company.

**Rockwell-Republic V-10 regulating valve** with Type J-1 positioner is designed for rugged high-pressure liquid or steam service.




**Quick-change Trim feature** makes it possible to replace the seat guide (A), inner valve (B), and seat (C), without removing valve from the line. Seat extends to valve outlet to prevent body erosion.

REPUBLIC INSTRUMENTS AND CONTROLS
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...on the

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DIVISION OF S. T. JOHNSON CO.
Church Road, Bridgeport, Pa.

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## Valves, piping

Begins on page 216

charts. One section compares ductile iron and other material. Stockham Valves and Fittings

**371** **End fittings** for low-, medium- and high-pressure hose assemblies are described in 4-p pamphlet IEB-53. Aeroquip Corp

**372** **Steel and brass** tube fittings and hose are features of 16-p catalog C-301. The Weatherhead Company, Fort Wayne Div

**373** **Tube fittings** of corrosion-resistant stainless steel are subject of 4-p folder 4323B1. Parker-Hannifin Corp

**374** **Rotary joints** requiring no lubrication and working for single-flow or siphon steam service are topics of 4-p catalog 310B. Barco Mfg Company

**375** **Unions and union fittings** are cataloged in 16 pp on design, weights and dimensions. Stockham Valves & Fittings Company

**376** **Venturi accessories** are topic of 4-p pamphlet. Covers straightening vanes, vent cleaners and flushing devices. B-I-F Industries

**377** **Threaded inserts** and studs are subject of revised 28-p catalog D. Describes 1-piece floating miniature, solid and hydraulic inserts with and without internal thread lock. Newton Insert Company

**378** **Seamless welding fittings** and flanges are featured in 8-p brochure FB-502A. Carbon, alloy and stainless steels are covered. Babcock & Wilcox Company

**379** **Cast-aluminum welding fittings** for installing extruded-aluminum integral steam-traced piping are covered in 2-p bulletin TL-1. Alcast Fittings

**380** **Strainers,** thermostatic and expansion steam traps are illustrated and explained in 20-p catalog 400. One chapter helps determine proper size. W H Nicholson and Company

**381** **Strainer selection** procedure is simplified in 12-p catalog 6008. Self-cleaning strainers are used for steam, air, gas, and liquid service. Leslie Company

**382** **Steam traps** are the subject of 10-p pamphlet T-1743—gives capacities, dimensions, weights and prices. Yarnall-Waring Company

**383** **Impulse-steam-trap** selector and piping-diagrams booklet for petroleum-processing equipment, 32 pp, includes sizing, installation info, 26 capacity tables. Yarnall-Waring Company

**384** **Steam traps,** temperature regulators are featured in condensed


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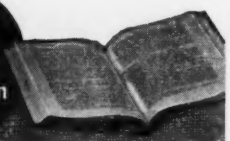

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A practical manual for the mechanical services covering steam plants, heating systems, air conditioning and ventilating systems, diesel plants, refrigeration, and water treatment. Helps you select, apply, and design virtually every type of instrument and control system. By H. P. Kallen, Kallen & Lemelson. 692 pp., 520 Illus., $15.00

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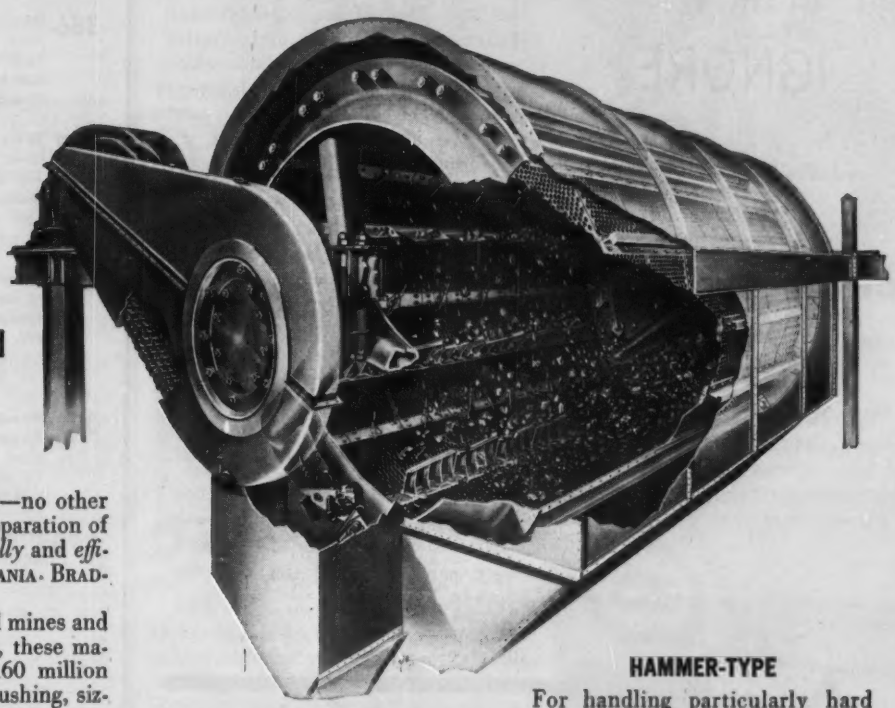
# For maximum economy in preparation of ROM coal—it's PENNSYLVANIA BRADFORD BREAKERS



**Trunnion-mounted**
**Roller-mounted**
**Hammer-type**

Mine-side or plant-side—no other crusher handles the preparation of ROM coal as *economically* and *efficiently* as a PENNSYLVANIA BRADFORD BREAKER.

At power plants, coal mines and by-product coke plants, these machines prepare over 160 million tons of coal a year—crushing, sizing and scavaging all in one continuous operation, at capacities up to 1500 TPH, and at average maintenance costs as low as $.001 per ton and power consumption averaging .204 KW per ton.

ROM coal is continuously charged at loading end. Passing sizes are immediately screened out. Larger lumps are raised by radial lifting shelves and dropped, breaking along natural cleavage planes to desired screen size, with minimum fines.

Refuse such as bony, sulphur balls, slate and rock, resist breakage, are automatically discharged at the refuse end along with tramp iron, timbers, etc.

### ROLLER-MOUNTED

Roller-mounted BRADFORD BREAKERS are particularly adapted for use at coal mines, as the spider at the loading end is designed to permit loading of extra large lumps of coal.

### TRUNNION-MOUNTED

Trunnion-mounting, where the revolving cylinder is suspended on trunnions, is the popular type for plant-side installations.

### HAMMER-TYPE

For handling particularly hard coals, or for heavier loading, the BRADFORD BREAKER is combined with a concentrically-mounted rotor of a hard-hitting PENNSYLVANIA HAMMERMILL at the rear end of the breaker.

Whatever the type most suitable for your need, if it's *economy* and *efficiency* you want—investigate PENNSYLVANIA BRADFORD BREAKERS. Write for catalogs, or call a Pennsylvania Engineer.

**PENNSYLVANIA CRUSHER DIVISION**
BATH IRON WORKS CORPORATION
WEST CHESTER, PENNA.

**PENNSYLVANIA CRUSHERS**
BATH-BUILT

# CORROSION
## COSTS LESS TO STOP THAN IGNORE

Schaub Deaerators make corrosion more unnecessary than ever. Guaranteed to remove oxygen down to .005 cc/liter (Zero-Oxygen type), Schaub Deaerators stop the deadly corrosive action of oxygen in raw water which spells the early and costly replacement of boilers and lines. Your equipment will last longer and you'll get improved operating efficiency to boot!

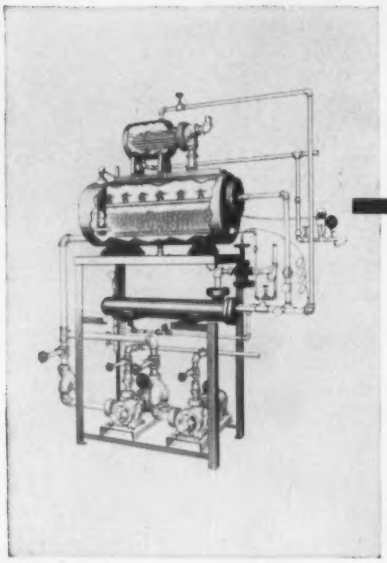
**SCHAUB DEAERATORS**

*guaranteed corrosion protection for any size plant*

All Schaub Deaerators operate *fully vented* at atmospheric pressure for complete release of all air — without expensive pressure vessel construction. ".03" type uses exclusive Schaub spray-contact vent condensing method to stop wasteful steam vapor loss. Pinpoint temperature control and "live-action" heating insure highest-efficiency operation regardless of load variations.

Schaub Deaerators bring truly effective low-cost corrosion protection within the reach of *any* plant . . . make it more expensive to ignore corrosion than to stop it.

*Write today for full information.*



**SCHAUB ZERO-OXYGEN DEAERATING SYSTEMS**—(illustrated) for capacities to 250,000 lbs./hr., are **guaranteed** for .005 cc/liter oxygen removal over a 10 to 1 load swing—**without** sodium sulphite. Features Schaub explosive flashdown and fully vented operation.

**SCHAUB ".03" DEAERATING SYSTEMS**—for the small to medium size plant in the 3,000 to 100,000 lbs./hr. range. **Guaranteed** oxygen removal down to .03 cc/liter under even widely varying load conditions. Fully vented operation.

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☐ Schaub Zero-Oxygen Deaerators

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Company_____
Address_____
City_____ Zone_____ State_____


## Valves, piping

*Begins on page 216*

10-p catalog. Charts and tables aid selection. Sarco, Inc

**385** **Sight flow indicators,** flapper and rotary with threaded and flanged connections, are subject of 4-p bulletin 18W. Schutte and Koerting Company

**386** **Diaphragm-seal** pressure-snubber unit for sealed systems protects against corrosion and plugging—see 4-p brochure for full details. Chemiquip Company

**387** **Wire-mesh filter assemblies** — over 225 items of 20 basic types —are covered in 22-p bulletin. Data sheets list standard units and describe optional installations and applications. Pall Corp

**388** **Cleaner-snubber** is used in place of separate air-intake filters for reciprocating compressors, blowers, gas or diesel engines. See 6-p bulletin from Burgess-Manning Co, Industrial Silencer Div

**389** **Bands, hose clamps,** couplings, flanges, V-band joints are covered in 44-p catalog 803. Features, design info, specs speed ordering. Aeroquip Corp

**390** **Detachable, reusable hose fittings** are covered in color-coded 8-p brochure. The Lenz Company

## ● Maintenance, insulation and materials

**Just circle key numbers on Reader Service card, p 197, for complete details**

**77** **Electronic vertical balancers** — single-plane units — balance rotating parts up to 200 lb and 30 in. in diameter. They are simpler and faster to operate than cradle devices, maker claims. Four potentiometers permit four separate calibrations of the meter. After reference-mark location and amplitude of unbalance are noted, electric braking stops rotating piece quickly. Piece is returned to position shown by strobe light and heavy or light spot shows up. Switch determines whether weight is to be removed

Begins on opposite page

or added, depending on lightness or darkness of spot. Price: $2750. —Industrial Balancer Dept, Stewart-Warner Corp

**78** **Vibration-isolation pads** use specially processed high-density fiberglass. Elasticity of the glass fibers combines isolation efficiency with internal damping. Chatter caused by externally excited vibration is eliminated in precision machines. Pads come in 18x18x-12-in. sheet, prescored at 2-in. intervals so they can be cut to size easily, right on the job and with a penknife if necessary. Your maintenance men can install them without cementing, sawing, floor drilling—or waiting.—Consolidated Kinetics Corp

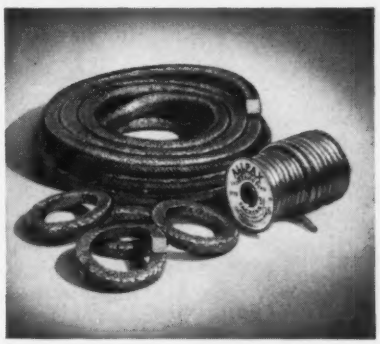
**79** **Transistorized balancer**—a good *PM* tool—is portable for use on location—also sets up as a permanent installation in test stands. Four amplifier and control-unit combinations are available. Vibration amplitude at pickup location can be indicated or amount of unbalance shown in terms of the correction method used. Angles are shown in one or two planes of correction. Five filter arrangements cover speed increments between 300 and 150,-000 cpm. Base cost for balancer, vibration pickup and stroboscopic lamp: $1740.—Gisholt Machine Company

**80** **Analyzer-balancer** is designed to study vibration in machinery, buildings, pipelines. Modular construction and transistorized circuitry promise reliable operation using little power. You select voltage input manually for various measurements. Range from 50 microvolts to 100 v lets you measure amplitude from 5 micro-in. to 100 millinches peak to peak, frequency from 3 to 10,-000 cps, velocity from 50 micro-in. to 100 in. per sec at ±2% accuracy. Model 41 analyzer, velocity pickup and strobe light cost under $2000. — RayData Corporation

**81** **Magnetic crack-detector probe** weighs 14 lb. Portable NDT detector for cracks in ferrous metals is a U-shaped 2-pole electromagnet energized by a 6- or 12-v automobile storage battery or a


# When CHEMICALS enter the PACKING PICTURE

For use on equipment which handles chemicals, we make a wide variety of packing materials to fill different needs. Among them are:



**Style No. 4**

**WHITE ASBESTOS PACKING**—for use against hydrochloric, muriatic and phosphoric acids, sulphurous and caustic alkali solutions, for temperatures up to 600 degrees F.

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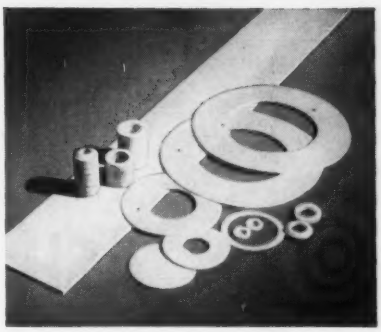
**BLUE ASBESTOS PACKING**—for use against sulphuric, benzoic and hydrofluoric acids, caustics, ferric chloride, etc., for temperatures up to 550 degrees F.

**"Teflon" Products** – "Teflon" does not melt or flow, and is the finest material known for use against solvents, acids, alkalies, caustics, etc. Recommended over a temperature range from –80 to plus 500 deg. F. Tensile strength ranges between 1500 and 2500 P.S.I. Can be used in combination with other sealing materials. Furnished in molded rods, tubes, V rings, solid ring gaskets, sheet, envelope gaskets, tape, O rings, and braided forms.



**Style T-5,** impregnated packing.

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If you need the solution to a specific problem, we invite you to call upon our service department, which will give your inquiry its immediate attention.

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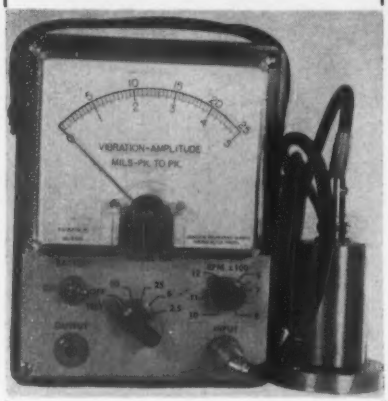


By using non aging transistors and tantalum capacitors, with a long life mercury battery, an ideal portable instrument has been developed with remarkable stability and the high accuracy necessary for spotting loss of weight in a turbine spindle. With a seismic vibration pick-up it is as easy to read Vibration Amplitude as voltage, and with equal precision.

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411—15th Street, Virginia Beach, Virginia

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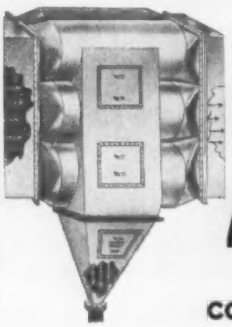
**REGENERATIVE**



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- ★ For All Plant Arrangements and Sizes

***Write for Bulletin F***

**BRESLOVE SEPARATOR COMPANY**
COMMONWEALTH BUILDING
PITTSBURGH 22, PA.

circle 902 on Reader Service card, p 197


## Maintenance

Begins on page 228

110-v service outlet (in this case, through a built-in rectifier). Operator coats the area he wants to examine with a ferromagnetic powder, then places the detector so its two poles bridge the area. A discontinuity in the metal alters the magnetic flux patterns in the powder, showing nature and extent of the flaw. — Westinghouse Electric Corporation, X-Ray Dept

**82** **Instant-mix powder concentrates** for the wet method of visible and fluorescent crack detection feature easier mixing, handling and storage, more fluorescent brilliance, less foaming, better corrosion protection. You can add these concentrates directly to your tank of oil or water; they go into uniform suspension almost immediately.—Magnaflux Corp

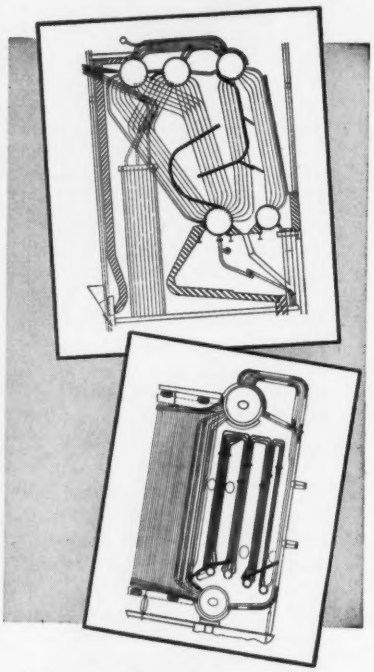
**83** **Ultrasonic flaw detector** measures thickness of metals and plastics from one side to accuracies within 0.010 in. Caliper attachment is essentially a fixed, scribed, vertical line with second line on a slider moving across face of cathode ray. Synchronized dial indicator measures amount of this motion. You can also locate hidden discontinuities, voids and slag inclusions, determine their depths. — Branson Instruments, Inc

**84** **Machine cuts clean** — surface finishes finer than 100 rms are common. It cuts an 8-in. steel I-beam in less than 18 sec, costs well under $2000. Plates, too, can be handled—unit will cut through a 3x24-in. plate in about 4 min. It also cuts aluminum, brass, copper, most plastics. — Wallace Supplies Mfg Co

**85** **Adjustable-diameter bolts** give exacting radial fits in all holes. You can have any degree of tightness, compensation of wear with no pressing or careful matching of bolts to holes. Wall-thickness bushings permit bolts to slide easily into hole bore to be tightened to exacting degrees. Anyone can do it—there's no training involved.—Adjustable Bushing Co

**86** **Welding package** for thin-gage metals promises speed and versatility at low cost. Package in-


**ONLY ENCO BAFFLES give you all these COST CUTTING FEATURES**



These important fuel-saving maintenance-reducing features are obtainable with Enco boiler baffles—*and only with Enco baffles.*

- **Streamlined gas flow**
- **Uniform gas flow**
- **Elimination of bottlenecks**
- **Reduced draft losses**
- **Higher heat transfer**
- **Cleaner heating surfaces**
- **Less use of soot blower**
- **Special provision for expansion**
- **Easy tube replacement**
- **Adaptable to any water-tube boiler, fired by any fuel**

Each application is designed on the basis of more than a quarter century of experience in this specialized branch of power engineering. Installations are made by skilled mechanics.

**THE ENGINEER CO.**
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ANOTHER ACHIEVEMENT IN MODERN FLOW CONTROL BY CRANE

## CRANE PRESSURE-SEAL BONNET GATE VALVES

are built to meet the toughest demands of high pressure/temperature steam and power piping systems. Special metals—silver, stainless steel, chrome and Stellite* guard all critical valve areas:

1 chrome-plated retaining ring remains freeze-free for easy dismantling; 2 precision tapered silver-plated seal ring eliminates bonnet joint leakage; 3 stainless steel inlay in body insures tight sealing, maximum protection against corrosion; 4 Stellite-faced seating surface and seat rings are engineered for trouble-free, minimum-maintenance service.

Crane Pressure-Seal Bonnet Gate Valves are armored with special metals and careful engineering details. Full travel disc guiding prevents wear and drag on seating surfaces. Flexible wedge disc won't stick even when the valve is closed hot and opened cold. Valve yoke is mounted to the body, transmitting operating torque directly to the valve. The smooth flowing contour design allows straight-through flow with no turbulence.

These gates are your best bet for long, safe, dependable service.

**Sizes 1" to 24"; 600-, 900-, 1500- and 2500-pound classes**

*Stellite is a registered trademark of Union Carbide Corp.

All Crane Pressure-Seal Bonnet Valves are ASA-rated. Minimum metal thicknesses comply fully with the requirements of ASA B16.5–1957, the ASA Code for Pressure Piping and the ASME Boiler and Pressure Vessel Code.

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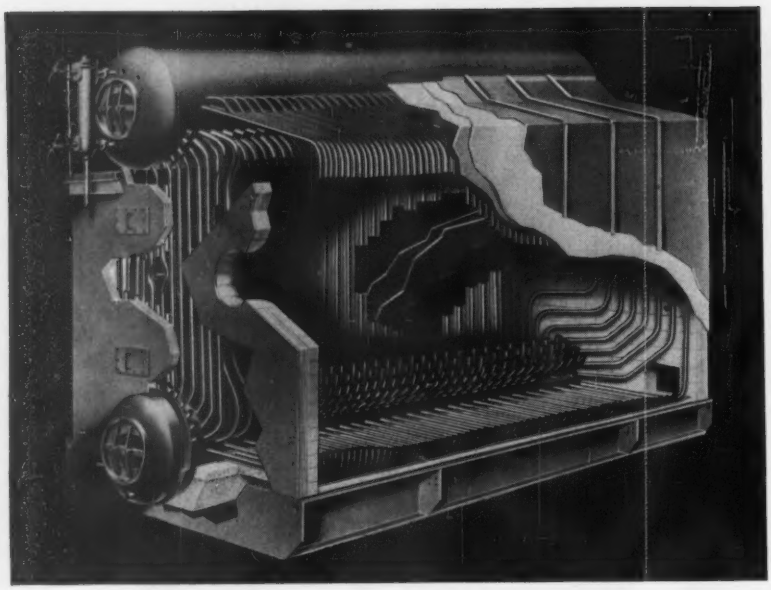
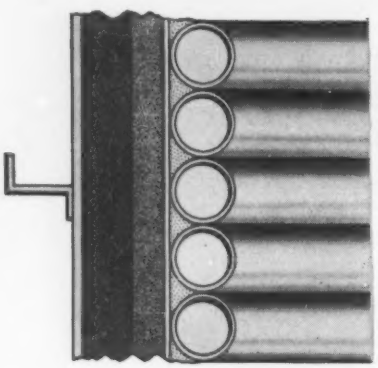


# BROS boosts boiler efficiency by putting heating surfaces where they should be!

Heating efficiency in BROS Series "P" Package Boilers is exceptionally high. There are many reasons.

One is the fact that a large proportion of the heating surfaces are *inside the furnace* where heat absorption is highest. A relatively small portion is located in the convection zone.



**OUTER FURNACE WALL** (Above) is built of welded 10-gauge steel reinforced by Z-bars. Next are 1½" and 1" blankets of medium and high temperature insulation, then 16-gauge inner casing. Trowelled refractory between tubes provides smooth surface for inner casing.

**FURNACE FLOOR TUBES** are bare and not covered by refractory. Space between tubes and plate is filled with loose insulation. Radiant heat prevents condensation and corrosion of tubes.

Inside the furnace, all heating surfaces are *tubes*. These provide far more direct (and consequently more efficient) heat contact than do the extended surfaces so often found inside other furnaces.

Here are some other reasons why BROS Package Boilers will give you greatest operating economy.

- **Horizontal cross-flow of gases provides maximum and efficient heat transfer.**
- **Tangent tube furnace walls provide maximum furnace heat absorption, decrease loss by radiation. Tubes on floor, sides and roof, along with coverage of rear wall, minimize furnace refractory maintenance.**
- **Deep furnace provides long flame travel.**
- **No waterwall headers to slow the circulation or complicate cleaning. Furnace tubes are continuous from drum to drum. There are no handholes to maintain.**
- **Heavy all-welded structural steel base distributes weight over a large floor area. No special foundation is needed.**

BROS "P" Boilers are compact, self-contained, pressurized furnace units with capacities of 10,000 to 100,000 lbs. steam per hour. Standard design capacities are 200 and 250 psig but similar boilers for higher pressures and temperatures can also be supplied.

For illustrations, features, drawings, specifications and complete performance data, see your nearest BROS Representative . . . or write

*POWER DIVISION*

BROS *Incorporated*

1057 Tenth Avenue S. E., Minneapolis 14, Minnesota


## Maintenance

*Begins on page 228*

cludes 200-amp silicon-diode-rectifier power source, wire-driven system, straight-through torch weighing only 22 oz.—Westing-Arc Dept, Westinghouse Electric Corporation

**87** **Manual gun and controls** for gas-shielded metal-arc welding are designed for light or heavy fabrication where numerous short welds, off-the-ground welding or emergency repairs are necessary. Operator can weld as far as 50 ft away from the control panel and control panel can be placed 150 ft from the power source. Gun carries its own compact reel of wire, weighs 2½ lb. — Air Reduction Sales Company

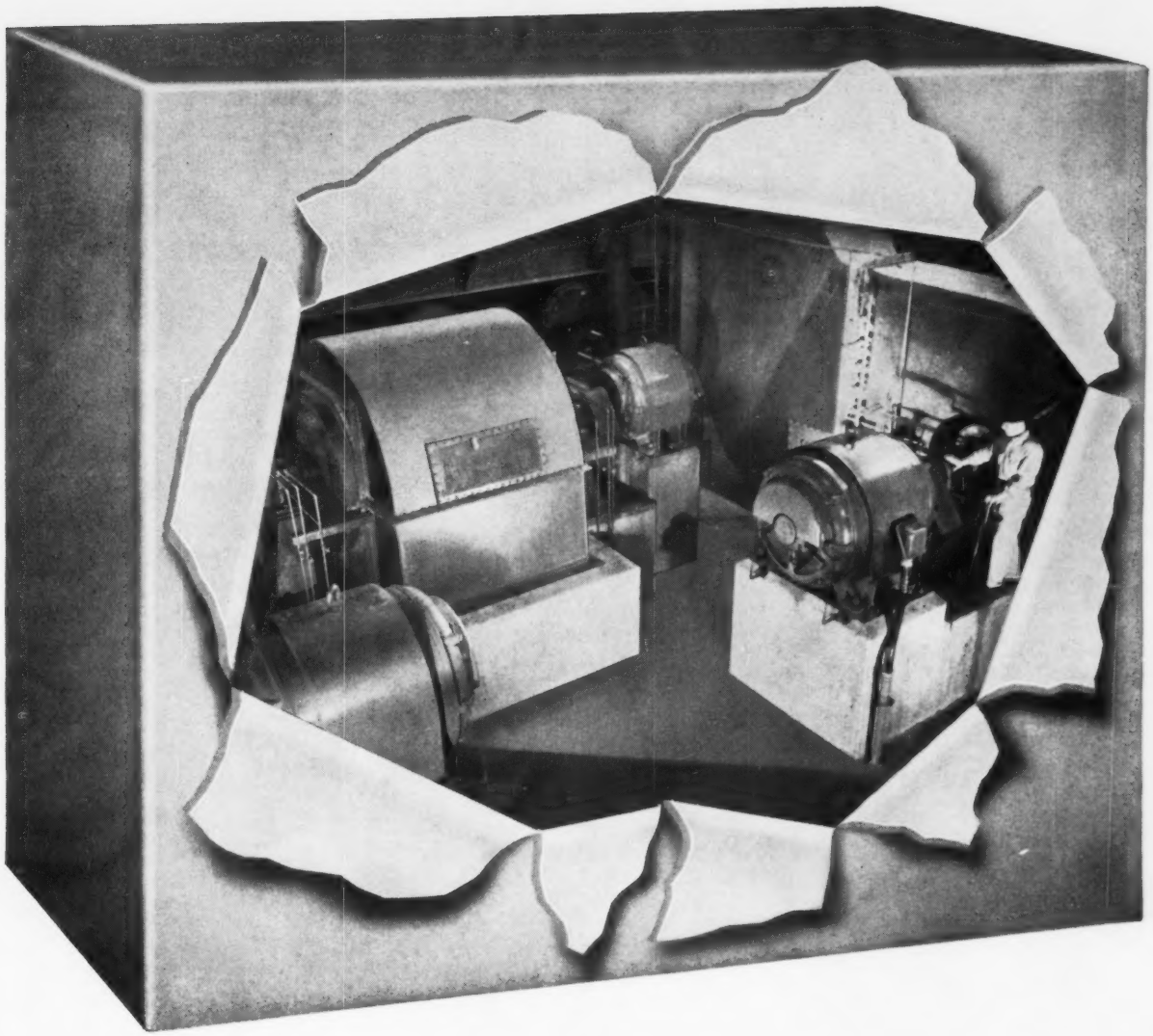
**88** **Nonwoven graphite** and carbon felts can be used to insulate, filter gas or for gaskets. Air oxidation will be no problem up to 700 F; felts handle temperatures to 5000 F. Strength at 3000 F is doubled at room temperature; electrical resistance decreases at 2500 F to about half room-temperature value. Eight grades are available in sheets 32- to 36-in. wide, 36- to 87-in. long.—National Carbon Company

**89** **Fibrous glass** molded acoustical insulation replaces pasted insulation, reduces overall insulation costs. Molded in specially designed shapes, insulation is now being used to deaden noises from air-conditioning compressors but is available for a wide variety of insulating tasks. Insulation is molded in two halves for simple assembly, then sprayed with vinyl surface coating for easier handling. — Fibrous Glass Products, Inc

**90** **Solid urethanes** can be compounded to your specifications in rod and cast parts, sheet or tube. They combine high tensile strength, abrasion resistance, elasticity and resilience in varying degrees for many applications—those suggested are chute linings, vibration pads, gaskets, belts.—Armstrong Cork Co, Industrial Div

**91** **Densified wood,** compressed under great heat, is made of beech veneers and solid beech blocks. It's strong and tough as metal

**continued on p 238**



## More power to ALTON BOX BOARD

## . . . with the help of CLARAGE

Mechanical draft is among several assignments of Clarage equipment at Alton Box Board Co., Alton, Illinois.

On the left above in the power plant, a Clarage Type W, Class III double inlet fan equipped with Vortex Control provides forced draft . . . on the right is one of the two Clarage Type RT double inlet fans furnishing induced draft.

Investigate the advantages dependable Clarage equipment offers for YOUR mechanical draft installation. Contact our nearest sales engineering office or write us for complete literature.

*Dependable equipment for making air your servant*

# CLARAGE FAN COMPANY

*Kalamazoo, Michigan*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

For more facts circle 925 on Reader Service card, p 197

circle 926 on Reader Service card for following ad ➤

Son, we call this
a "Fisher"

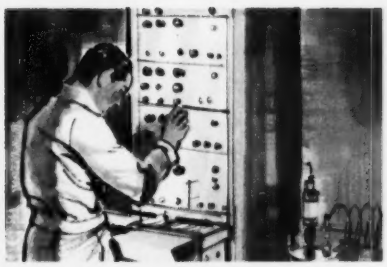
# The worthiness of a name

In refineries, chemical plants, and oil fields, many "old timers" associate the name "Fisher" with high quality control valves and liquid level controllers. Through the years, in their work on instruments and controls, they have come to know that "Fisher" means dependability.

"Put a 'Fisher' in the line, and forget it." they would always say.

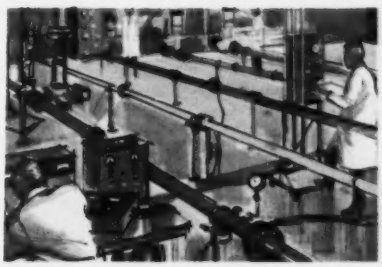
The quality found in Fisher equipment lies not only in metal and fiber and paint. It is also found in the practical design, manufacturing techniques, and the rigid inspection program. These high quality factors along with outstanding research and engineering facilities assure you of trouble-free performance. Throughout the world, "Fisher" means dependable control equipment.

**FISHER GOVERNOR COMPANY** *Marshalltown, Iowa / Woodstock, Ontario / Rochester, England*

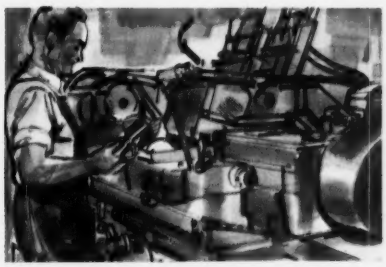


**Continuous Advanced Research . . .** Fisher research maintains a continuous program for development and use of new metals and materials to meet the increasingly severe conditions, encountered daily, in the nuclear and cryogenics fields.

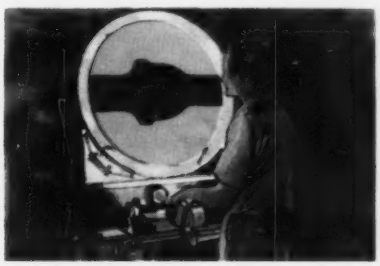
**Engineering and Research . . .** Almost three-fourths of Fisher's 41 graduate engineers have more than 10 years service . . . a total of 380 years experience in design engineering aimed at solving industry's flow control problems, practically and efficiently.



**Testing and Development . . .** Representative of the very latest and finest in equipment that aids Fisher engineers in the development of new and improved products is the recent addition of a test line that is capable of handling air or water pressures up to 2,500 psi.



**Latest Production Methods . . .** Various new style grinders produce a super-finish on Fisher valve guides and bushings, second to none in the industry. It is typical of precision manufacturing methods that assure long, trouble-free operation of Fisher controls.



**Rigid Inspection Procedures . . .** The highest ratio of inspection personnel to production personnel in the industry is maintained at Fisher. As an example, there are no less than 704 inspection operations on a 4" Type 657-A diaphragm control valve.

**Efficient and Fast Service . . .** "Supermarket" 36-hour delivery, from the factory, on popular sizes and types of controls is only one of many services available to Fisher customers. Seventeen sales offices throughout the country maintain field stocks for immediate delivery.

*If it flows through pipe anywhere in the world ...chances are it's controlled by.....*

FISHER® Controls SINCE 1880

In 1953 a leading oil company used **Gilsulate** to insulate and protect underground hot pipes at their New Jersey plant.

This was followed by installations at their Bulk Storage Plant in New York, and their refineries in Louisiana and New Jersey.

And in 1958 they used over 650 tons of **Gilsulate** to protect their underground hot pipes at their Research Center in New Jersey.

## Why? *The Answer is obvious:*

From the standpoint of installation cost, thermal efficiency and service life, there is no better method of insulating and protecting underground hot pipes against corrosion, chemical and electrical attack than the use of GILSULATE.

Let us send you technical information on GILSULATE. Once you have learned the merits of this poured-in-place material we feel certain you will want to write your "specs" to assure the use of GILSULATE. And remember, the installation of every GILSULATE job is engineer-supervised from start to finish.

**The insulation for superior protection of underground hot pipes**

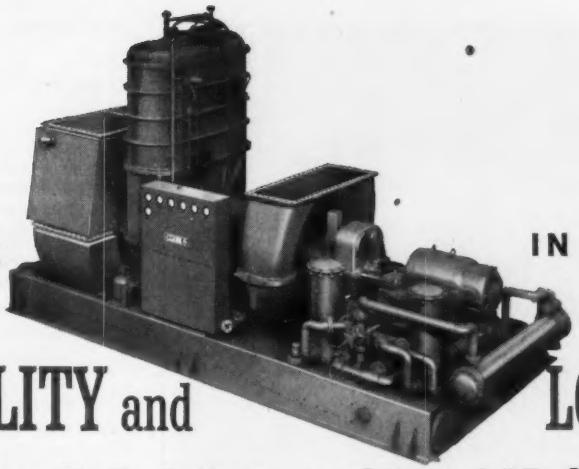
**Gilsulate®**

**American Gilsonite Company** | Municipal Airport P. O. Box 15 | Salt Lake City, Utah

Affiliate of Barber Oil Corp. & Standard Oil Co. of California • Distributors in Principal Countries of the World



**For more facts circle 927 on Reader Service card, p 197**

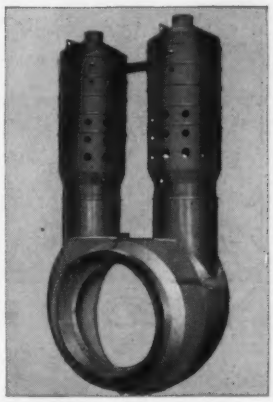


Clark Model 305-S, single shaft gas turbine rated at 9000 hp.

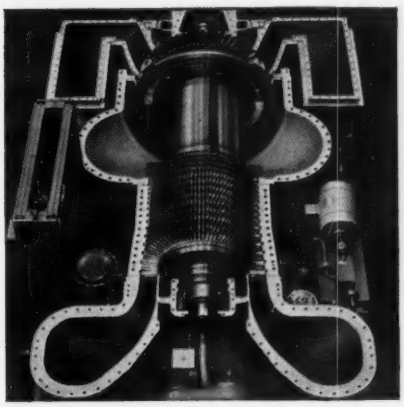
# IN GAS TURBINES YOU LOOK FOR RELIABILITY and LOW FIRST COST

## Here's why you'll find them in Clark 305 Series Gas Turbines

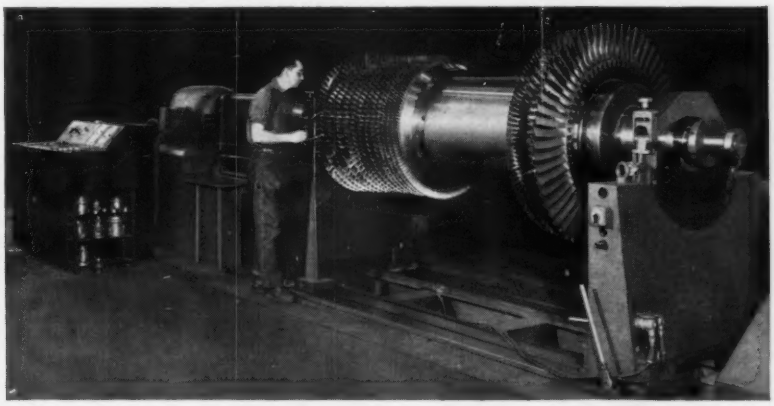
- **Heavy Duty Industrial Design**—Simple, open cycle machines, built for continuous, full load operation . . . ideal drivers for compressors, generators and pumps.
- **Single Shaft Construction**—Provides high rotating inertia and minimum speed variations under transient load conditions. Two-Shaft units available for applications requiring wider operating flexibility.
- **Design Simplicity**—Integral compressor-turbine rotor is supported by two readily accessible journal bearings. Entire unit including combustion system is contained in common casing structure.
- **1400°F Operating Temperatures**—Insure long life of hot parts plus substantial margin of safety.
- **Air Cooled**—Pressurized air cools high temperature components . . . air envelopes minimize heat loss and operating temperatures wherever possible.
- **Vertical Combustion Chamber**—Prevents direct flame impingement on turbine blading . . . assures more uniform heat distribution.
- **Horizontally Split Casing**—Upper half can be removed in one piece to remove rotor . . . inspections quickly made using light lifting equipment.
- **Renewable Labyrinth Seals**—Of honeycomb construction . . . minimize leakage at all close clearance points on turbine shaft.
- **Proved Reliability**—Materials of construction and important components such as turbine blade root design, turbine discs, journal bearings and axial compressor based on broad Clark experience in building heavy duty gas turbines.



Unitized combustion chamber with two parallel burners, each enclosed in a liner of high temperature nickel chrome alloy.



Single rotor is supported by two journal bearings for greatest simplicity. Horizontally split housing provides easy accessibility.



Rotor is statically and dynamically balanced for optimum performance. Turbine blades are of high temperature forged steel. Air streams cool turbine blade roots and both sides of discs.

CLARK BROS. CO. OLEAN, N. Y.

ROOTS CONNERSVILLE — Blowers, Compressors, Gas Pumps, Rootsmeters, Vacuum Blowers

*Working together in allied industries . . .*

PODBIELNIAK — Centrifugal Contactors, Distillation Apparatus, Instrumentation

CLARK GAS TURBINES — DRESSER INDUSTRIES INC. — OIL • GAS • CHEMICAL ELECTRONIC • INDUSTRIAL



For more facts circle 906 on Reader Service card, p 197

but a lightweight in comparison and easier to machine. It's used for bearings, sheaves, connectors, switchgear as well as insulating. For electrical equipment, beech veneers .040 or .078-in. thick before compression are cross bonded with 26% phenolformaldehyde resin and pressed under heat to a density of 1.30 to 1.34 specific gravity. One nuclear use: neutron shielding.—Lignostone Import Co

## • Maintenance design aids

**391** **Ultrasonic - cleaning** equipment catalog includes tips on purchasing equipment, lists cleaning compounds. Well-illustrated 24 pp give complete specifications and ordering information required. National Ultrasonic Corp

**392** **Industrial vacuum cleaner** is described in 20-p handbook. Boiler and electric-motor cleaning, salvaging usable waste—a few of the 79 applications mentioned. Breuer Electric Mfg Company

**393** **Making maintenance** parts is topic of 16-p booklet which offers ideas on how to save time in machining parts, eliminate heat treating and quench cracks. Physical properties of steel bars used in parts are given. La Salle Steel Company

**394** **Operating and maintenance** instructions for welding plastics are given in 4-p manual 60-2. Hand, medium- and high-speed welding are described. Kamlar Products Company

**395** **Sulfamic-acid cleaners** are discussed in booklet showing equipment-cleaning hookups. E I du Pont de Nemours & Co

**396** **Chemical cleaning** of boilers, auxiliaries and heat exchangers is subject of 12-p booklet from Dow Industrial Service

**397** **Powdered-acid cleaner** for use in boilers, heat exchangers, water lines and pumps is subject of 4-p folder HSP-940. Hagan Chemicals & Controls, Inc

**398** **Rust prevention** and removal are detailed in bulletin 16B: removing rust from raw stock with inhibitors, preventing rusting between processing operations. Oakite Products, Inc

**399** **Machinery vibration,** shock and noise are topic of 8-p bulletin K4G explaining 27 types of products for measurement and control. The Korfund Co, Inc

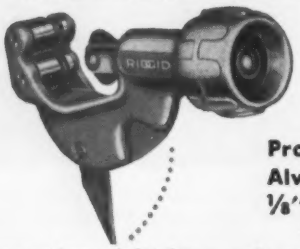
2 New
RIDGID
Tubing Cutters
Give you Grooved Rollers for close flare cut-offs... no waste! Also, Enclosed Feed Mechanism • Spare Cutter Wheel in Handle •
Fold-in Reamer

**RIDGID No. 205 Tubing Cutter**

**Time-Saving, Slide-to-Size ⅛" to 2⅝" O.D. Capacity**

Made of lightweight, high-strength cast aluminum alloy, you'll find these new RIDGID Tubing Cutters extra handy. Slight push on handle of large-size-range RIDGID No. 205 snugs cutter wheel against tubing . . . locks it in position until released. Feed screw fully protected and enclosed . . . always feeds into tube with easy handle turn . . . can't jam with chips or dirt. Wheel gives quick, clean cuts of copper, brass, aluminum tubing and thin-wall conduit . . . no burr. Grooved rollers give easy flare cut-offs without tubing waste. Tubing always turns freely on 2 of 4 Rollers. Rollers smooth tubing ready for soldering. Fold-in reamer always handy. Spare cutter wheel in handle. Wheel for plastic and aluminum pipe available for No. 205 only.

**Conform to Fed. Spec. GGG-C-771b Type II—Class I—enclosed feed mechanism**



**RIDGID No. 105 Tubing Cutter**

**Protected Feed Screw**
**Always Easy-Turning**
**⅛" to 1⅛" O.D. Capacity**

**To save time and tubing, order these new RIDGID Tubing Cutters today!**
**Your Supply House has them!**

RIDGID

The Ridge Tool Company, Elyria, Ohio, U.S.A.

Begins on page 228

**400** **Nondestructive-testing** equipment is described in 12-p bulletin 00-105. Application and specs for portable X-ray and magnetic-particle inspection equipment are covered. Sperry Products Company

**401** **Two wall charts** compare traits of various flames, show welding and cutting flames. Smith Welding Equipment Corporation

**402** **Silver brazing alloys** are topic of 24-p revised manual—also discusses brazing procedures, problems and solutions. Air Reduction Sales Company

**403** **Preheating and stress-relieving** problems are discussed in 32-p booklet EW-249. Post-heat treatments for welded joints and repairing thermocouples are chapters. Hobart Brothers Company

**404** **Hardfacing electrodes and wires** are discussed in a 44-p brochure. Type of wear on each equipment part is listed with alloy needed to protect it. Air Reduction Sales Company

## • Insulation and materials

**405** **Applications** of thermal insulations from 400 to 3000 F are described in revised 64-p catalog IN-244A. Temperature limit is given for all equipment. Johns-Manville Corporation

**406** **Methods and equipment** for testing insulating materials are discussed in booklet G-65 available from Associated Research, Inc

**407** **H-t insulation** for industrial piping is topic of 4-p brochure available from Owens-Corning Fiberglas Corp

**408** **Silicone-rubber insulating tape** is described in bulletin 18,110. Tables shows grades, sizes, tolerances and typical properties. Continental-Diamond Fibre Corp

**409** **Insulating materials** developed from fluorocarbon resins have temperature range of −100 to +250 C. Details are given in booklet available from Irvington Div of Minnesota Mining and Manufacturing Co

**410** **Calcium silicate** and mineral-wool-block insulation for temperatures up to 1900 F are detailed in 4-p bulletin 6451. The Philip Carey Mfg Co

**411** **Fiberglass applications,** characteristics, specs are listed in brochure. Applications include vi-

Don't take our word for it—try a new RIDGID Flaring Tool! See if you don't get smoother, stronger, more uniform flares . . . in less time and with less effort than ever before!

Then, compare this new RIDGID Flaring Tool, feature-by-feature, with any flaring tool you've ever seen or owned: • Feed releases automatically when flare is fully formed. • Reversing feed screw burnishes flare. • Hardened steel die bars are precision-machined. • Large, comfort-grip feed screw handle turns easily. • Precision-ground, hardened steel flaring cone, eccentrically mounted in precision bearings, produces rolling action for even metal flow . . . gives uniform flare walls without galling. • Tubing hole sizes are clearly marked. • Easy sliding rugged malleable yoke serves as stop for tubing to give correct flare size. • Yoke clamp screw fits into centering hole . . . locks bars, yoke and tubing into perfect alignment. • Stop pins keep yoke on die bars at all times . . . yoke can't slide off.

**3 Models:**
RIDGID No. 457 for 45° flares, ⅛" to ⅜" O.D. (7 sizes)
RIDGID No. 459 for 45° flares, ⅛" to ¾" O.D. (9 sizes)
RIDGID No. 376 for 37° flares, 3/16" to ⅜" O.D. (6 sizes)

See and try these new RIDGID Flaring Tools. Your Supply House has them.

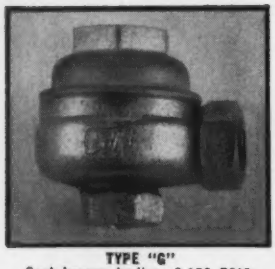
RIDGID Work-Saver Pipe Tools

RIDGID
The Ridge Tool Company, Elyria, Ohio, U.S.A.



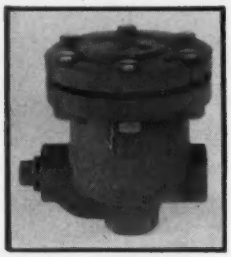

For more facts circle 908 on Reader Service card, p 197

# WITH STEAM TRAPS TOO—

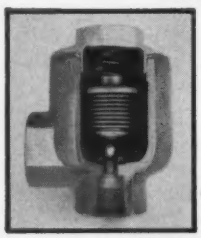


TYPE "G"
Cast bronze bodies. 0-150 PSIG.
½" & ¾"

TYPE "L"
Cast steel bodies. 0-300 PSIG.
½" & ¾"



TYPE "P"
Semi-steel bodies.
0-250 PSIG.
½" through 2"
Also available as
Type "R" in cast steel.



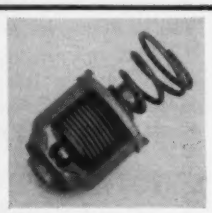
TYPE "S"
Cast bronze bodies.
0-250 PSIG.
½" through 1"

## YOU DESIGNED THE B&J STEAM TRAP

Because you wanted the many advantages of thermostatic traps — high air and water capacities, simplicity, single orifice size over full pressure range, the ability of repairing and maintaining right on the line with a minimum of shutdown time and labor cost, plus dependable uniformity of operation obtained by calibration. Calibration permits use of a **one-piece interior** that makes the dream of simplified maintenance come true.

## WHAT IS INSIDE THE B&J STEAM TRAP

A one-piece operating mechanism. A "Trap Within A Trap." All working parts of the B&J trap, bellows, plug **and seat** are locked in calibration inside a stainless steel cage which is completely independent of all tolerances in trap body and cover. **Not** a collection of parts to install, but a **single** piece to drop in while the trap is on the line.



CAGE UNIT
One-piece trap interior. Monel Bellows, Stainless Steel Plug & Seat. Calibrated for sensitivity.

**BARNES & JONES, INC.**
34 Crafts St. • Newtonville 60, Massachusetts




bration damping, molded insulation. Fibrous Glass Products, Inc

**412** **Thermal-insulation** master spec covers fire-retardant materials. Copies of 27-p report are available from Insul-Coustic Corp

**413** **Cost comparison** of insulations for underground heat-distribution systems is subject of 4-p report issued by Ric-wiL, Inc

**414** **Metallic protective coating** for mild steel is described in brochure. Includes corrosion-test-data report presented by Detroit Edison Co to ASME. M L Sheldon & Co, Inc

**415** **Cutting downtime with metal** is topic of 6-p bulletin. Case histories cover flame spraying with metals in wire and powder form. Metco Inc

**416** **Zinc coating** can be brushed on iron or steel for rust protection. 4-p brochure pictures application and upkeep. Sealube Company

**417** **Cold-applied protective coatings** are described in bulletins T-197-3, T-97-61. Koppers Co

**418** **Silicones** for the chemical-process industries are topic of brochure 1-119. Dow Corning Corp

**419** **Silicone rubbers,** room-temperature vulcanizing, are covered in 12-p bulletin S-3. New member of silicone family is introduced. General Electric Company

**420** **Silicone-rubber selector** guide is one section of 8-p brochure CDS-129C. Categories include silicone fluids, protective coatings, electric insulation. General Electric Company

**421** **Synthetic-rubber compounds** and protective coatings are described in 16-p catalog. Gives applications of resins, primers and epoxies. David E Long Corp

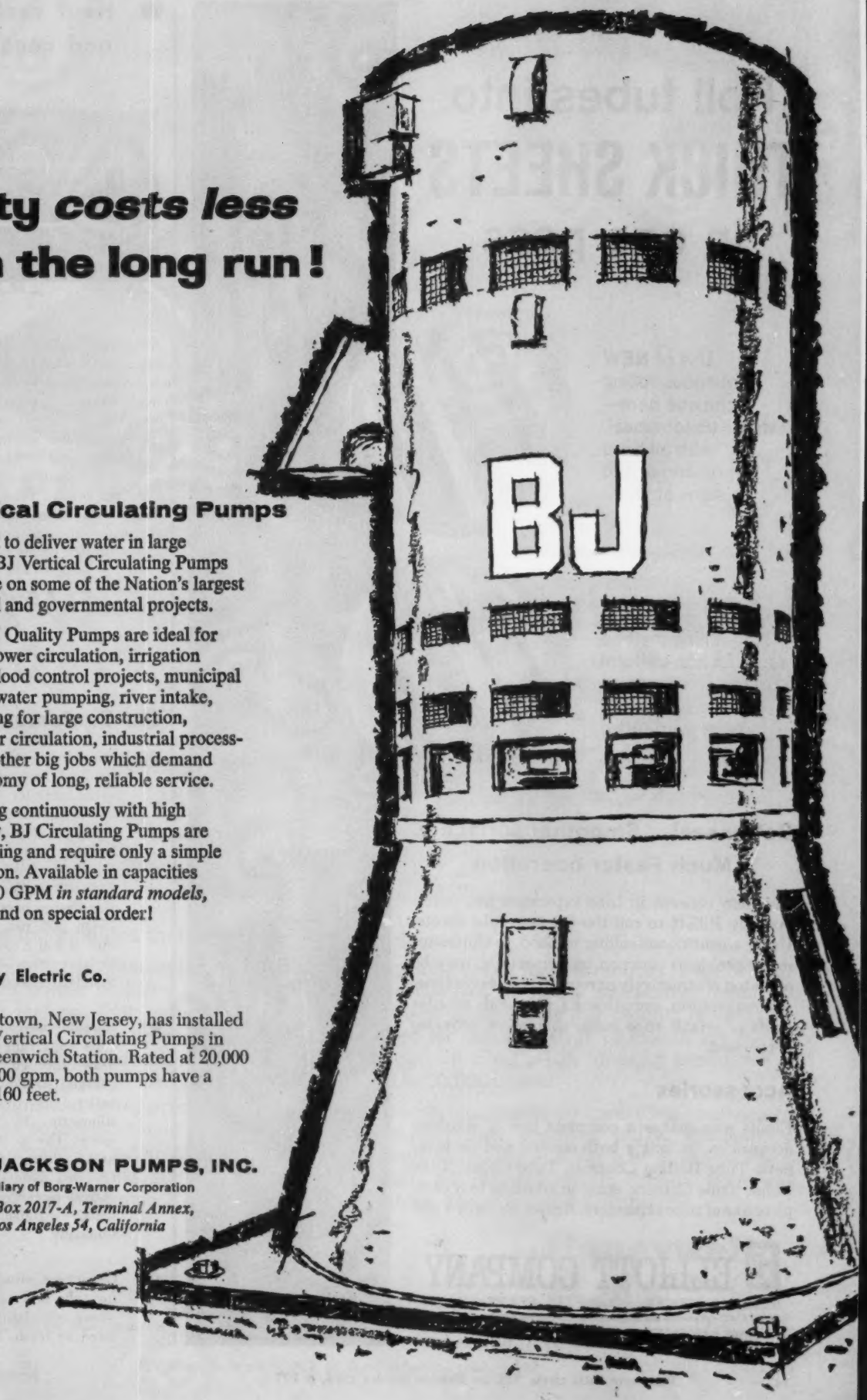
**422** **Thermal insulation** is designed for 200 to 1200 F. Physical properties, fittings and heat transmission are chapters of 14-p bulletin IN-39. Keasbey & Mattison Company

**423** **Industrial insulations** are topic of 20-p publication. Products mentioned: fireproofing cement, pipe covering and block insulation, protective coatings and seals. The Eagle-Picher Company

**424** **Corrosion-resistant coatings** 4-p folder 259 refers you to catalogs of company's products. Wisconsin Protective Coating Corp

Just circle key numbers on the Reader Service card, page 197, to get your design aids

# Quality *costs less* in the long run!




## BJ Vertical Circulating Pumps

Designed to deliver water in large volume, BJ Vertical Circulating Pumps are in use on some of the Nation's largest industrial and governmental projects.

These BJ Quality Pumps are ideal for cooling tower circulation, irrigation service, flood control projects, municipal primary water pumping, river intake, dewatering for large construction, condenser circulation, industrial processing and other big jobs which demand the economy of long, reliable service.

Operating continuously with high efficiency, BJ Circulating Pumps are self-priming and require only a simple installation. Available in capacities to 50,000 GPM *in standard models,* and beyond on special order!

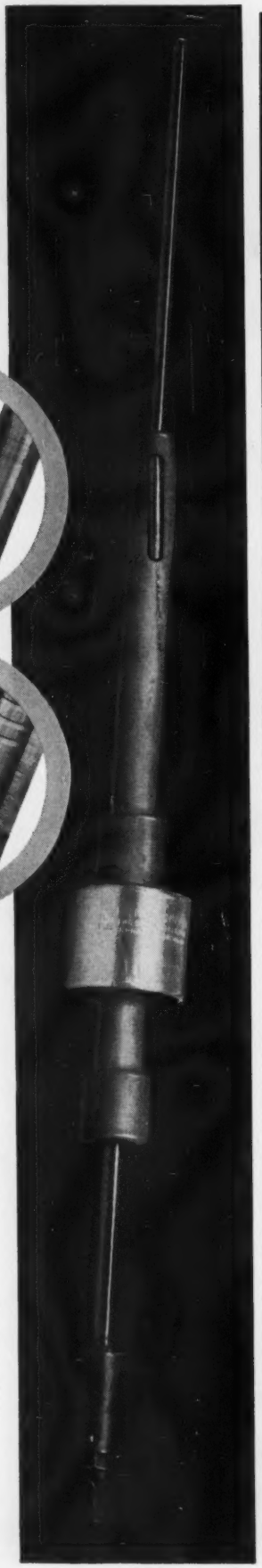
**Atlantic City Electric Co.**

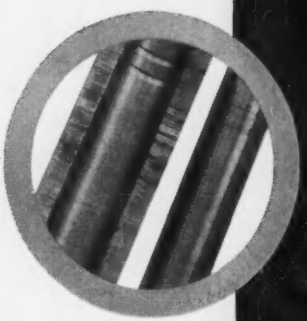
of Gibbstown, New Jersey, has installed two BJ Vertical Circulating Pumps in their Greenwich Station. Rated at 20,000 and 10,000 gpm, both pumps have a head of 160 feet.

**BYRON JACKSON PUMPS, INC.**
Subsidiary of Borg-Warner Corporation
*P.O. Box 2017-A, Terminal Annex,*
*Los Angeles 54, California*

BW

# Roll tubes into THICK SHEETS in one pass





Use of **NEW** continuous-rolling technique here—shows uniform seal, with all Keys preserved, and no signs of shear

**OLD** step-rolling method results in non-uniform surface . . . distortion of Keys where rolls have overlapped

## Better seal . . . Smoother surface . . . Much Faster operation

This new concept in tube expanders was developed by Elliott to roll the thickest tube sheets. Using a continuous-rolling method, it eliminates many problems common to step-rolling, may be operated protractively or retractively, saves time, assures uniform, smooth surfaces, avoids annular voids or erratic tube inside diameters, provides better seal.

## Accessories

Elliott also makes a complete line of retubing accessories, including both electric and air magnetic Tube Rolling Controls, Tube Gages, Tube Plugs, Tube Cutters, etc.—in addition to a complete line of tube expanders. *Ask for Bulletin Y-52.*

Y1-4

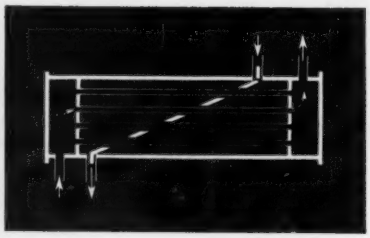
ELLIOTT COMPANY

*GENERAL OFFICES: JEANNETTE, PENNSYLVANIA*

*PLANTS AT: Jeannette and Ridgway, Pa.; Springfield, Ohio;*

TURBINES • GENERATORS • MOTORS • COMPRESSORS • TURBOCHARGERS • EJECTORS • STRAINERS • TUBE CLEANERS


## ● Heat exchangers and condensers



Simplified application of heat exchangers through standardized nomenclature is starting to take hold. Needed step here: standardization by industry association. This will cut down application errors and misunderstandings between user and maker.

Tests continue on new tube materials for heaters (see pp 156-157) and condensers. Aim: nail down fouling, corrosion and erosion characteristics and establish better heat-transfer data.

T. M. Edwards

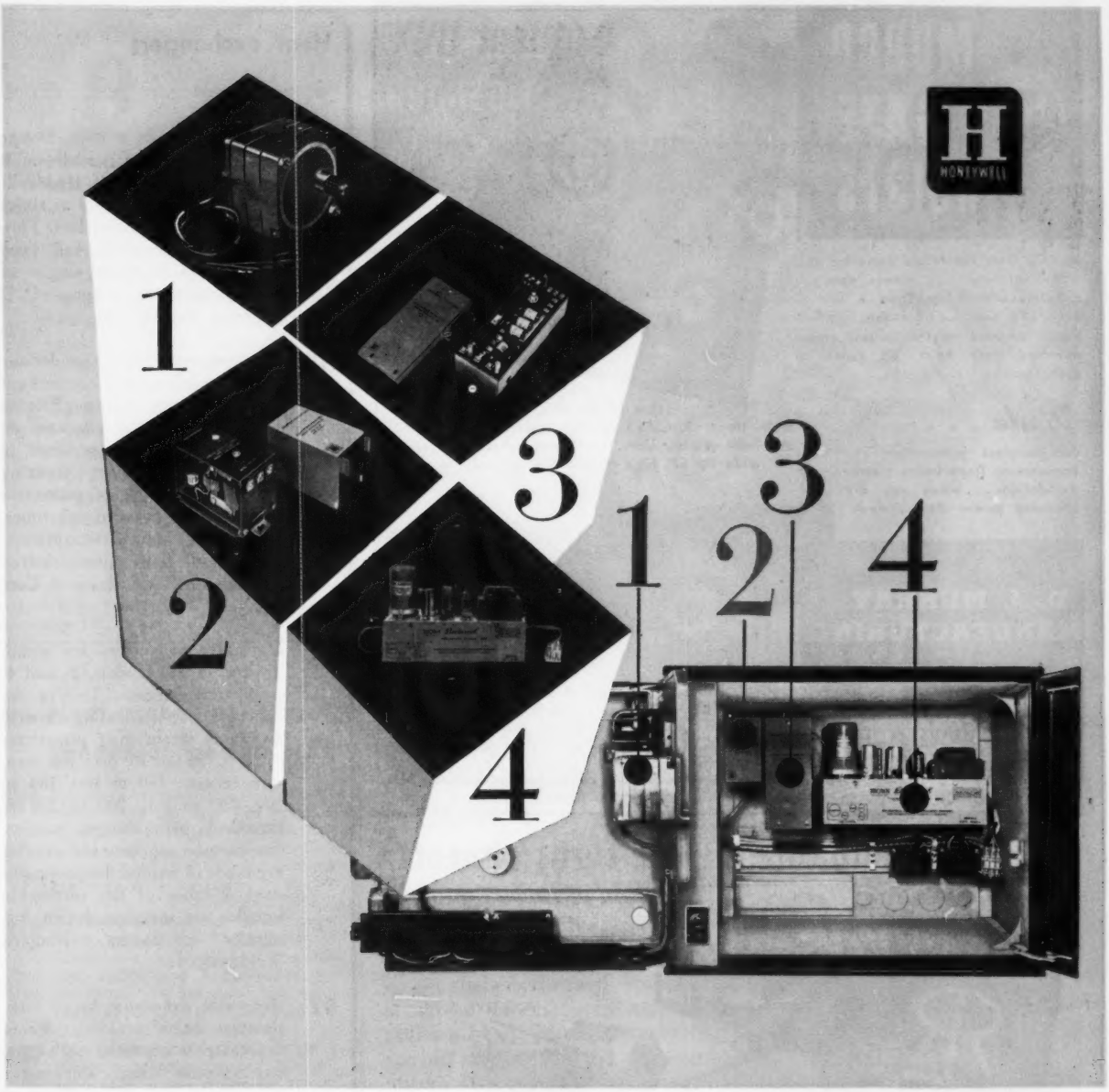
Associate Editor

## ● Equipment designs

92 **Standard components** are assembled into custom-built heat exchangers for specific chemical- and industrial-processing requirements. C-200 exchangers will handle any combination of liquids and gases. Shell sizes: 8 to 42 in. Shellside and tubeside design pressures range from 75 to 300 psi, design temperature is 400 F—or as high as 650 F in carbon steel.—American-Standard Industrial Div

93 **Remote air-cooled condenser's** coils are arranged in a V. Air is drawn through the coils and discharged straight up by the propeller fans—this provides a low silhouette in minimum floor space. The 3- to 10-ton-capacity unit has direct-drive fans, totally enclosed motors and lightweight corrosion-resistant aluminum cabinets. — Halstead & Mitchell Company

94 **Condenser eliminates downtime** for tube and tubesheet cleaning where circulating water is polluted by trash, leaves, algae, silt




**It's what's in the modules that matters!**

Take the newly designed modules in ElectroniK 15 Potentiometers. These modules have operating and servicing features that represent the very latest developments in the art of reliable instrumentation—**1.** Sectionalized motor module makes servicing a snap. Any major part of the servo or chart drive motors can be replaced in a matter of minutes. **2.** Line-powered constant voltage module provides a completely automatic d-c voltage source and replaces batteries, standard cells, and standardization mechanisms. **3.** Quick-change measuring circuit module reduces range or actuation changes to simple screwdriver operation. **4.** Quick-connect amplifier module is easily removed for servicing. Over 15 models available—for gain up to 40 x $10^6$, for input impedance of 400 to 50,000 ohms.

Get complete details by contacting your nearby Honeywell field engineer today. Minneapolis-Honeywell, Wayne and Windrim Avenues, Philadelphia 44, Pennsylvania. In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

**Honeywell**

First in Control

SINCE 1885

**HONEYWELL INTERNATIONAL** Sales and Service offices in all principal cities of the world. Manufacturing in United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.



For more facts circle 912 on Reader Service card, p 197

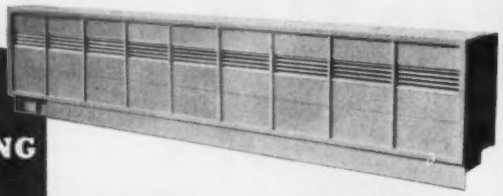
# MURCO GATE HOISTS

MURCO Gate Hoists are designed and made for any size power dam . . . capacities from less than 1 ton to over 375 tons . . . from the smallest hand operated to the largest motor operated gate hoist, all made to specifications.

One of the two 380-ton MURCO Gate Hoists furnished to the Power Authority of the State of New York. Each hoist operates a gate 46' wide by 67' high at one foot per minute.

*Write . . .*

for complete information . . . Engineering Department recommendations . . . when you are planning power dam projects.



. . . to Control Water Level at Long Sault Dam, St. Lawrence Power Project . . . For the second largest hydroelectric power plant in the United States at Massena, New York — as part of the St. Lawrence power project.

**D. J. MURRAY MANUFACTURING CO.**

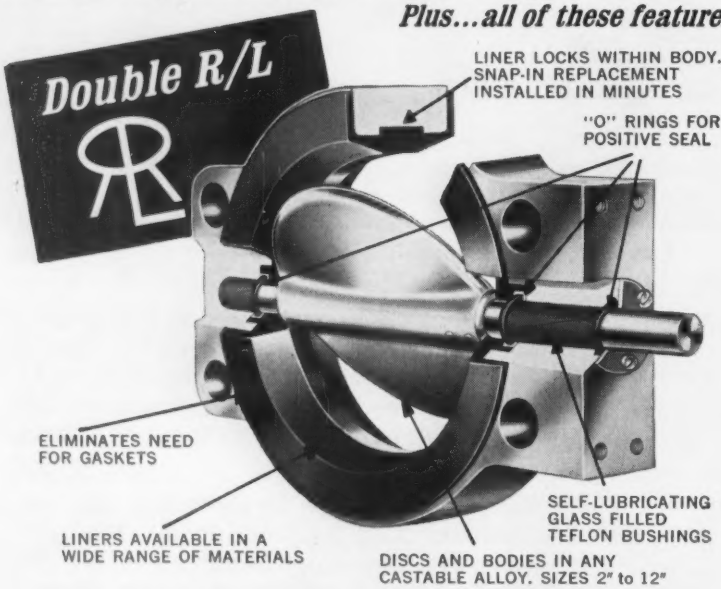
MANUFACTURERS SINCE 1883

WAUSAU · WISCONSIN

For more facts circle 913 on Reader Service card, p 197

## *NOW*...dependable bubble-tight shutoff

***Plus...all of these features***


Double R/L
LINER LOCKS WITHIN BODY. SNAP-IN REPLACEMENT INSTALLED IN MINUTES
"O" RINGS FOR POSITIVE SEAL
ELIMINATES NEED FOR GASKETS
SELF-LUBRICATING GLASS FILLED TEFLON BUSHINGS
LINERS AVAILABLE IN A WIDE RANGE OF MATERIALS
DISCS AND BODIES IN ANY CASTABLE ALLOY. SIZES 2" to 12"

## The Fisher-Continental *Double R/L* Butterfly Valve

Can be used for on/off or throttling control, using manual and/or power actuators. CONTINENTAL EQUIPMENT COMPANY (a Division of Fisher Governor Company), Coraopolis, Pa.

**Write for Bulletin 91**

*If it flows through pipe anywhere in the world . . . chances are it's controlled by . . .*

FISHER® Controls SINCE 1880

For more facts circle 914 on Reader Service card, p 197


## Heat exchangers

or other foreign matter. Design feature: reversing mechanism is within condenser itself. Hydraulic cylinder actuates valves or sluice gates without vacuum loss. Flow may be reversed at full load. Units come in either single- or divided-waterbox designs.—C H Wheeler Mfg Co

**95** **Tapered-end tubes** for condensers combat inlet-end erosion, may cut premature tube failure. Erosion is a thinning attack often caused by the air or sand entrained in sea or harbor water—scouring action removes tubes' protective surface film. Tapered-end tubes, having no sudden termination, should alleviate pressure-drop problems.—Chase Brass & Copper Co

**96** **Hot-water converters** are standardized in 114 models, 2- and 4-pass arrangements. They're designed for space-heating service. Available steam inlet pressures: 0, 2, 5, 10 or 15 psi; temperature ranges: 160 to 180, 180 to 200, 190 to 210, 200 to 220 F. Standard shells, flanges, nozzles, drains, tube supports and cradles are made of welded flange-quality steel. U-tubes of the removable bundles are seamless drawn Admiralty or copper. — Niagara Weldments Inc

**97** **Hot-water deaerator** keeps temperature below scalding; steam deaerator is operated at a partial vacuum using an ejector which removes corrosive gases and produces required operating vacuum. Resulting water is used at about 132 F—below the scalding point. This design can produce any water temperature depending on operating-steam pressure. — Permutit Div, Pfaudler Permutit Inc

**98** **Graphite heat exchanger** is said to provide true counterflow. Fluid flow on both sides touches graphite only—so unit is suited to heat transfer between corrosive liquids and gases, as well as more conventional heating or cooling corrosive solutions with steam or $H_2O$. You can use it from 1 to 6 center blocks, each 24-in. long, to give a range of heat-transfer area of 35.2 to 176.7 sq ft for the 3-pass model. Add-

Begins on page 242

ing center blocks increases capacity as required.—National Carbon Company

**99** **Floating-head** clamp-ring heat exchanger has removable bundles. Design makes tube cleaning easy and permits high thermal differential expansion. Pre-engineered units handle liquids and gases—even toxic, volatile or flammable combinations. They also serve as heaters, coolers, condensers or vaporizers. Shell- and tube-side design pressures range from 75 to 300 psi.—American-Standard Industrial Div

Just circle key numbers on the Reader Service card, page 197, to get complete product story

## • Heat-exchanger and condenser design aids

**425** **Steam-to-water** and water-to-water heat transfer are handled by these exchangers—described with engineering data, selection charts in catalog 601. Old Dominion Iron & Steel Corp

**426** **Double-pipe heat exchangers,** their installation and maintenance, are featured in 8-p guide 120. Parts and spare-parts inventories are itemized for each exchanger. Brown Fintube Co

**427** **Heat exchangers** with straight tubes, externally packed floating tube sheets and single or 2-pass design: topic of 12-p booklet. American - Standard Industrial Div

**428** **Counterflow block** heat exchanger is subject of 8-p booklet S-6813. Five flow arrangements use one, three and five passes. National Carbon Company

**429** **Water-cooled condensers** for refrigeration and air conditioning, mechanically cleanable, are topic of 8-p bulletin WC-300. Halstead & Mitchell Co

**430** **Air-cooled condenser** for horizontal or vertical air flow is depicted in 4-p circular 2232. Section describes unit's propeller fans and motors. Westinghouse Air Conditioning Div

**431** **Hot-water converters** are feature of 20-p bulletin 71. Metals and alloys for special fabrications are listed and method of selecting shell size and heating surface is included. Niagara Weldments Inc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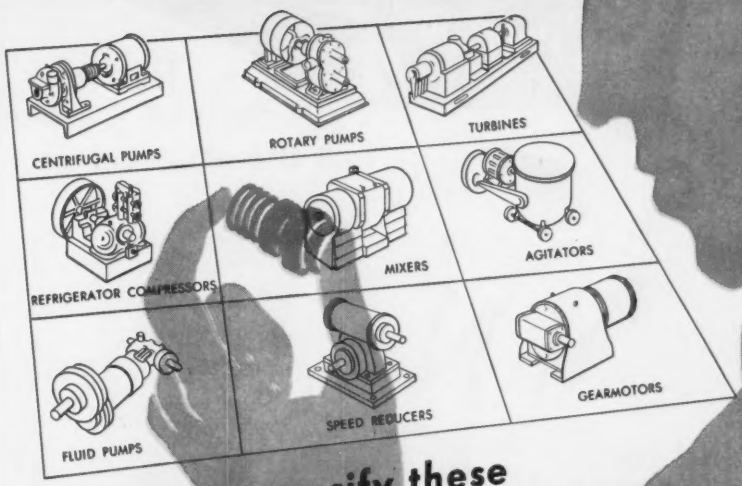
RUGGED FIELD PERFORMANCE *plus* PRODUCTION SAVINGS

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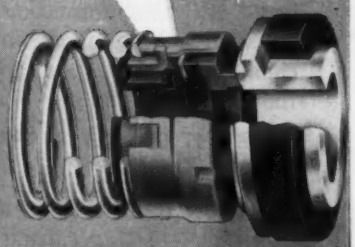
John Crane®

MECHANICAL SEALS

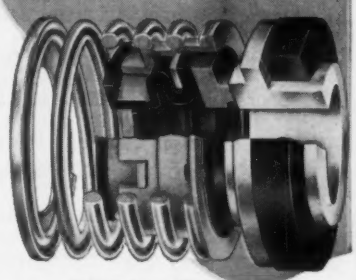
"JOHN CRANE" Types 1 and 2 shaft seals come pre-assembled. They are quickly and easily installed. Tolerances need not be critical due to the self-adjusting seal head. This is accomplished through special construction of the synthetic rubber bellows head. Moving freely under spring and hydraulic pressure, it automatically compensates for shaft end play, as well as washer wear.

Sealing faces are precision-lapped to prevent stuffing box leakage. No break-in runs necessary. Positive drive feature eliminates all stress on bellows. This feature also permits the use of light spring load to minimize wear on sealing faces. Seal needs no attention over long periods of operation.

Recommended for water, oil and other services non-injurious to synthetic rubber. Pressures to 550 psi. Temperatures: −40° to +212°F.



Type 1. For stuffing boxes of limited diameter.



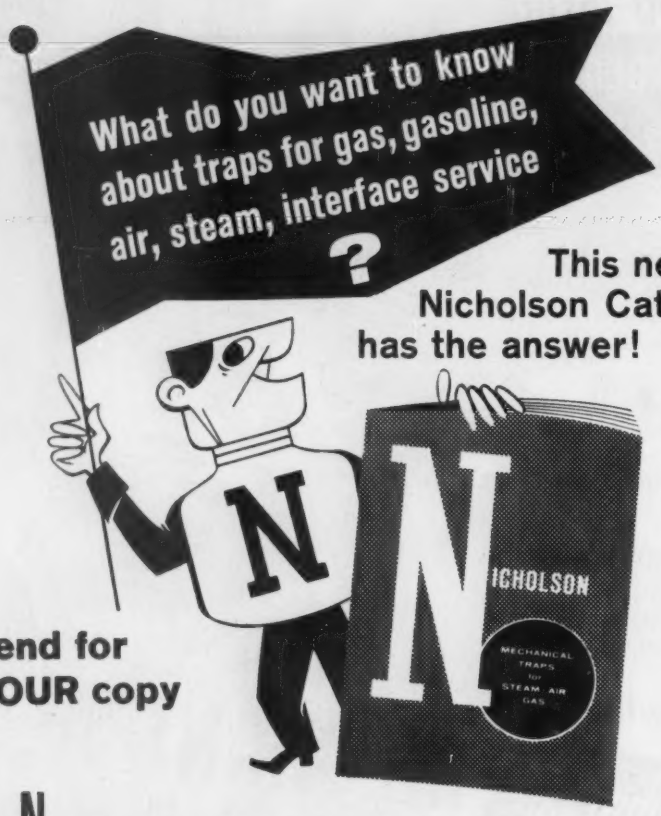
Type 2. For stuffing boxes of limited length.

*Write for Bulletin S-255*

Crane Packing Co., 6430 Oakton St., Morton Grove, Ill., (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

John Crane

CRANE PACKING COMPANY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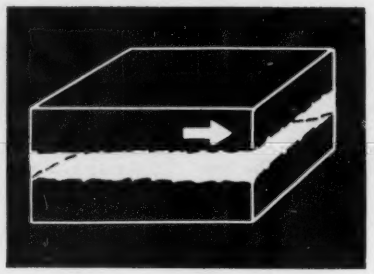
## ● Lubrication



Continuing development in the synthetic-lubricant field is easing many operating problems. Additives, too, can be selected to give just what you need. Wider use of fire-resistant lubes seems just around the corner. In turbine-generators, materials compatability—especially with generator insulation—has been the drawback. The energy-system engineer can now select his lubes from a wider list; he need not compromise.

V. W. Edwards

Associate Editor

## ● Lube equipment

**100** **Grease additive** UOP-225 has no metal or phosphorus, leaves no combustion ash. And it is stable at temperatures above 500 F. You can dissolve it in petroleum and synthetic lubricants. Additive offers corrosion protection for all bearing metals plus titanium, aluminum and magnesium. It's a good bet for steam-turbine lubricants since it will not dissolve in water.—Universal Oil Products Co

**101** **High-capacity separator** purifies lube oils, separates liquid from liquid, solids from liquid. It can separate sea water, solids and other contaminants at 12,000 gph. Operation is based on principle that oil is lighter than water and solid wastes. Purifier bowl spins at 4100 rpm, separating water and solids by centrifugal action. Unit is adapted from firm's disk type centrifuge. —De Laval Separator Co

**102** **Filter cleans hydraulic fluids** and other petroleum-based fluids as well as water to 3-micron cleanliness at rates up to 170-gpm continuous. Unit has high dirt capacity—no recirculation or preliminary filtration needed. Heart

Begins on opposite page

of the filter assembly is a fiberglass-membrane primary throwaway cartridge. Fiberglass combines fine filtration with large dirt capacity, membrane takes out large particles and stops migration. A third-stage woven-wire-mesh filter provides 98% 5-micron, absolute 18-micron filtration.—Aircraft Porous Media, Inc

**103** **Combination filter and reclaimer** has motor-pump set to force oil through filter. All or part of oil is diverted to reclaimer for final polishing and removal of moisture, water and other volatile contamination. Piping is arranged so reclaimer or filter can operate alone or in combination. Unit restores most lube and industrial oils.—The Hilliard Corp

**104** **Pneumatic lubricator** is basically an air-powered grease or oil cup with dual metering adjustments. Air regulator controls incoming air, small needle valve at lubricant outlet controls flow to bearings. You can operate in remote locations where plant air is not available since air tank is automatically recharged with each lubricant loading.

Unit will handle anything from light spindle oils to heavy grease. —Pan-Tech Engineering Co

## • Lubrication design aids

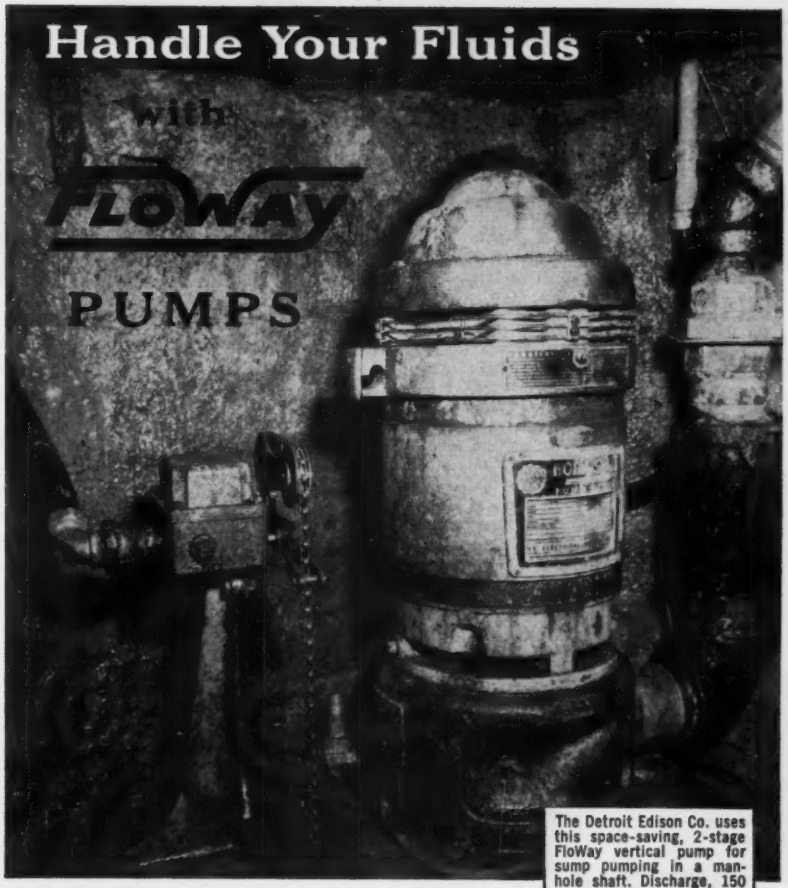
**432** **Solid-lubricants** booklet has 24 pp, covers advantages of molybdenum-disulfide lubricants available in powder form, grease, resin-bonded coatings and variety of special forms. The Alpha-Molykote Corp

**433** **Colloidal natural graphite** for lubrication and other uses is available in oils, water, synthetic esters and volatile carriers. 4-p bulletin is available from The Joseph Dixon Crucible Company

**434** **Solid-film lubricant** for most types of metallic surfaces is described in 2-p bulletin. Hohman Plating & Mfg, Inc

**435** **Antirust concentrate** for heavy-duty equipment-cooling systems is described in 8-p brochure. Lubrication Engineers, Inc

**436** **Lever guns** are subject of data sheet 732. Guns are set to handle lube cartridges and dispense bulk grease. Lincoln Engineering Co


The Detroit Edison Co. uses this space-saving, 2-stage FloWay vertical pump for sump pumping in a manhole shaft. Discharge, 150 gpm at 90' tdh with 5 hp, 3600 rpm motor.

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**U. S. Steel · Union Carbide · Detroit Edison · Chas. Pfizer**
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**Colorado Springs... and many others**

### Job Tailored Pumps

FloWay vertical and submersible pumps today handle just about everything fluid, from water for cities and cooling towers, to highly corrosive and volatile chemicals. Wide selection of components – heads, column assemblies, packing boxes, suction cases, impellers – enables us to "custom make" pumps suited to your problem... at competitive prices. Cast iron, bronze, stainless steel, special alloys, etc. are used, as required.

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Submersibles from 100 to 4000 gpm, 0-1000 psi, 1750 and 3600 rpm, for wells 8" and larger. Verticals from 15 to 5000 gpm, 0-1000 psi, 800-3600 rpm. Both types comply with AWWA and Hydraulic Institute specifications and are approved by Corps of Engineers for aircraft fueling.

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1

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For more facts circle 917 on Reader Service card, p 197

# measurement and control

of pressure and differential pressure

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**DELTADYNE® SWITCHES**
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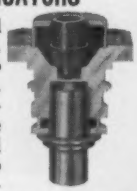
Adjustable for signalling pressure and differential pressure from 0.25" wc to 200 psi (or psid) in systems to 5000 psi and −65° to +275°F; leakproof. Units sound alarm, light bulb, turn motor on or off, operate valves — remotely or in place. $40 to $75

**DELTADYNE INDICATORS**



Adjustable and non-adjustable. Actuation 0.01 to 100 psi (or psid). For same pressure/temperature as switches. Red button pops to give visual indication of overpressure. $22 to $85

**DELTADYNE GAUGES**

For system pressures to 3000 psi; indication from 0 to 60 psi differential; leakproof — no moving seals; high-visibility scale. 0 to 60 psid, 3000 psi w.p. model. $92

**TRANSMITTERS** Complete with remote or in-place recorder.

**Extended pressure and temperature ranges available in all instruments.**

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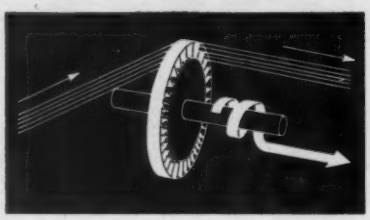
## ● Prime movers



Ever-growing demands for energy spark the design of wider variety of prime movers. We now range from giants of 900-mw-capacity steam turbines down to direct generators like thermoelectric units putting out a few watts. The problem of peak generation being attacked through low-cost oil and gas engines, gas turbines, steam plants and hydroelectric stations. Make a demand and you'll find a solution.

*B Ga Skrotzki*

Associate Editor

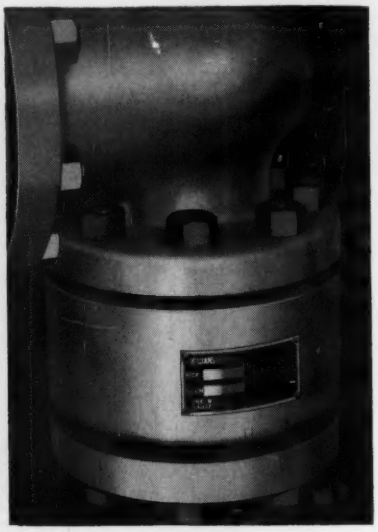
## ● Equipment

**105** **Electric-hydraulic** cabinet actuator uses static electrical components. Electric circuitry permits greater flexibility in arranging equipment; result: simpler plant layout. You can locate power mechanism close to turbine pit, mount controls on generator-floor benchboard. And your regular electrical maintenance men can service this governor. — Woodward Governor Company

**106** **Dual-fuel engines** bid for many jobs. They run on diesel oil or combustible gas with some diesel fuel added for ignition, come in two series: high speed, 47 to 140 hp; heavy duty, 150 to 500 hp. High diesel compression ratio of 14:1 maintains efficiency. Both types show rising torque curve with decreased speed. — Kromhout Motoren Fabriek

**107** **Mobile diesel set** offers up to 1500 kw. This powerful set can be rushed by highway to handle peak loads, standby or emergency service. It comes up to full load within 20 sec of demand. Engine combines diesel economy with gas-turbine weights, according to the manufacturer. Initial 1200-kw set is smaller than a standard semi-trailer. Weight: less than 30 lb per hp complete.—D Napier & Son (Canada) Ltd

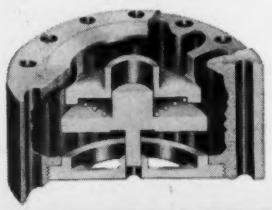
continued

# On the Boiler Feedwater lines in a large eastern paper mill . . .

Williams-Hager Silent Check Valves provide positive protection against surge pressures and resulting water hammer. Silent in service and rugged in construction, Williams-Hager check valves operate effectively regardless of their installation position.

**Write for Bulletins:** No. 654 on Valves, No. 851 on Cause, Effect and Control of Water Hammer; No. 659 on Pressure Loss Tests.



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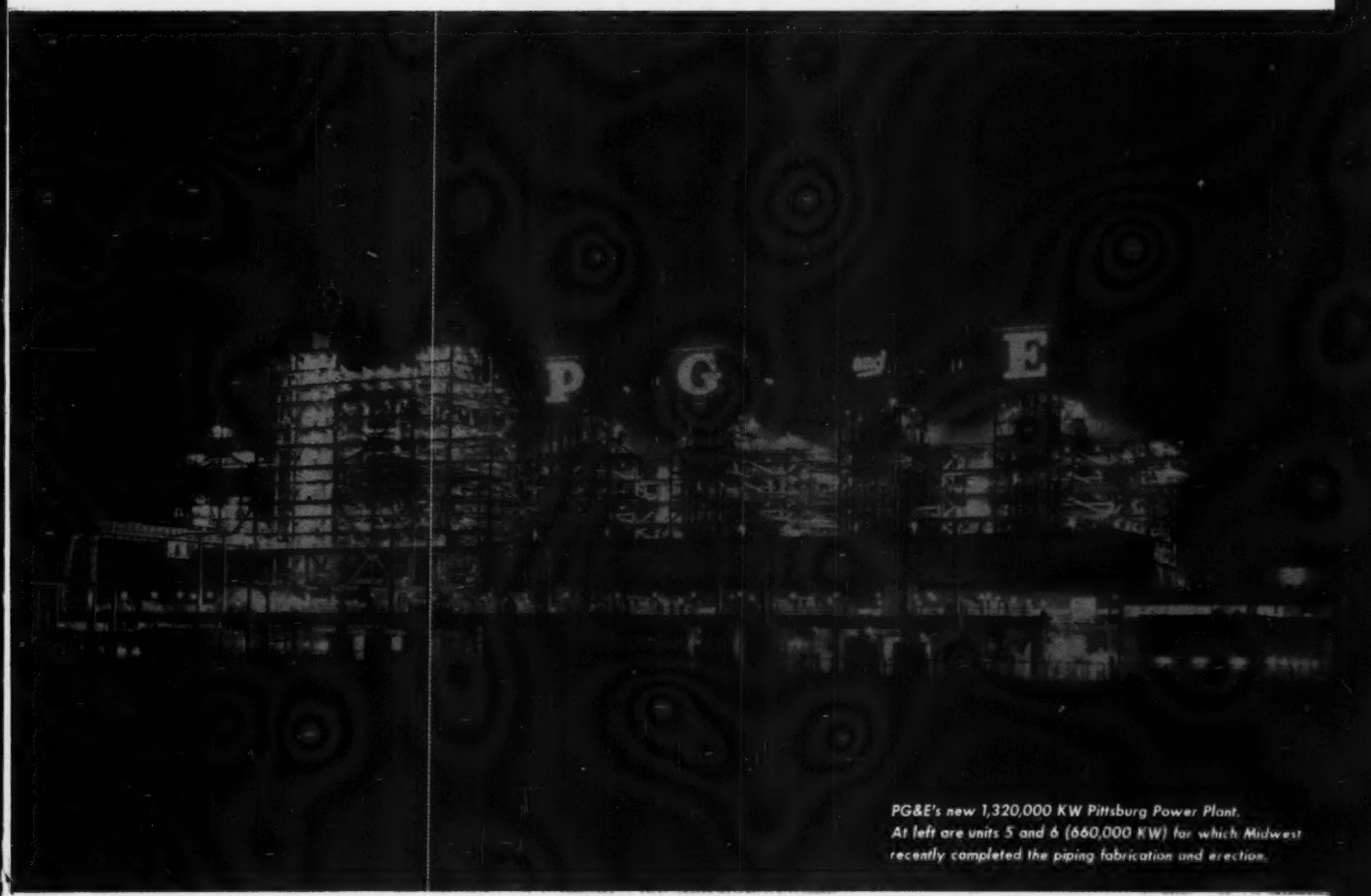
circle 919 on Reader Service card, p 197

# NEW PG&E UNITS PIPED BY MIDWEST

Pacific Gas and Electric Company, serving the rapidly growing region of Northern and Central California, has added 3,615,500 KW of steam plant capacity since World War II alone. Another 720,000 KW is scheduled for completion by mid-1963. Midwest is proud to have been the piping fabricator and/or erector for most of the new or expanded plant capacity completed to date or under contract, and to have been selected as the fabricator and erector for PG&E's newest project—units 3 and 4 at Morro Bay Station. In all, PG&E will have 26 generating units in 7 plants benefiting from power piping by Midwest!

For an illustrated booklet on Midwest's capabilities in piping, write for Bulletin 60B, POWER AND PROCESS PIPING.

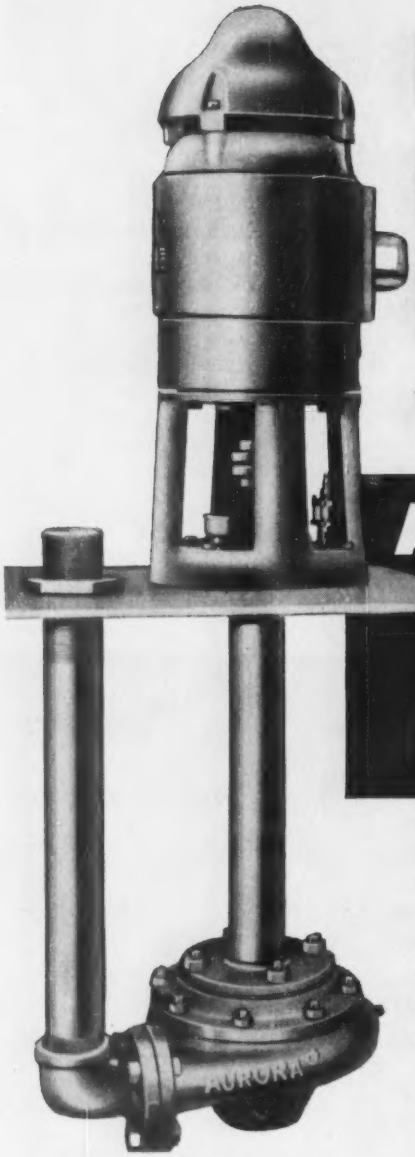



*PG&E's new 1,320,000 KW Pittsburg Power Plant. At left are units 5 and 6 (660,000 KW) for which Midwest recently completed the piping fabrication and erection.*

*A Division of Crane Co.* / *1450 South Second Street, St. Louis 4, Missouri*

MIDWEST PIPING

**For more facts circle 920 on Reader Service card, p 197**



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Ruggedness of construction and simplicity of design of AURORA pumps combine to provide longer life, highest efficiency, and minimized down time. This means more for "your pump operating dollar." Select from the "1001" types, sizes, and capacities of AURORA pumps to obtain *the one* specifically designed to fit your needs. AURORA sump type pumps are most frequently used for industrial wastes, industrial processing, boiler pit service, chemical transfer, corrosive liquid handling, pumping volatile liquids, washing services, and general purpose drainage.

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## Prime movers

Begins on page 248

**108** **Industrial gas turbine** develops 400 hp. Unit has centrifugal compressor, annular combustor, 2-stage turbine section and integral speed-reducing gear case. The 400-hp rating can be provided at output shaft speeds of 2500 or 3600 rpm. Free-shaft feature gives high torque at zero rpm.—Waukesha Motor Company

**109** **Governor control system** maintains speed of steam-turbine line shaft drives to within 1/10% of any set speed throughout 10:1 range. Completely static governor, prime sensing element in control system, signals speed to electric hydraulic converter. Converter's oil-pressure speed signal operates standard servomotor. —Westinghouse Electric Corp

**110** **Sprayed asbestos** is now available to insulate steam and gas turbines. Several inches of blue asbestos are sprayed directly onto castings of turbine's housing —no surface treatment required. Major benefit is significant cut in cost, maker states. Application takes ¾ the conventional time. —Keasbey & Mattison Co

**111** **Thermoelectric generator** puts out eight watts. Powered by natural gas, propane or butane, it shoots for duties operating valves on gas-transmission lines and cathodically protecting submerged metal. Generator measures 12x17 in., tips the scales at 65 lb. Other power ranges will be available later.—Texas Instruments

**112** **Smaller medium-speed** diesel engines—a first for this manufacturer — are multipurpose workhorses able to run for long periods without interruption. These engines will bid for standby and primary power service in hospitals and industrial plants; they'll power pumps and compressors. Five models, all operating at 1800 rpm, range from 110 hp, 4 cylinders, to 306 hp, 6 cylinders; both these ratings are turbocharged. The five models use only two basic bore and stroke sizes for maximum part interchangeability. — Fairbanks, Morse & Co

Just circle key numbers on the Reader Service card, page 197, to get complete product story

## • Prime-mover design aids

**437** **Economics** of gas-turbine-power generation—detailed in comparative analysis of gas-turbine, steam and diesel generating plants. Clark Bros Company

**438** **6500-hp gas turbine** is featured in brochure with specs. Orenda Engines Ltd

**439** **Re-entry-wheel turbine** is subject of 16-p pamphlet S-159. Discusses construction, features and governors. The Terry Steam Turbine Co

**440** **Single-shaft 9000-hp** gas turbine for mechanical and generator drive is presented in bulletin 186. Clark Bros Company

**441** **Mechanical-drive turbines** are single-valve multistage units with ratings to 4000 hp. Bulletin GEA-7152 is available from General Electric Company

**442** **LSV 4-cycle engines** for gas, diegel, dual- or 3-fuel requirements are outlined in 4-p folder 77-2. Describes turbocharger for supercharged engine. Cooper-Bessemer Corp

**443** **Steam-turbine 14-p** catalog 200 describes each construction feature, contains cross sections and parts list. Coppus Engineering Corp

**444** **Gas, duafuel and diesel engines** and pipeline pumping are some topics in 24-p product catalog available from Nordberg Mfg Co

**445** **Diesel engines** in 100- to 210-hp class are charted and illustrated in 4-p catalog BU-718. Allis-Chalmers Mfg Company, Engine-Material Handling Div

**446** **Engine compressors** are 2-, 4- and 6-cylinder balanced-opposed units in 200- to 1000-bhp range. 4-p brochure is available from White Diesel Engine Div, The White Motor Company

**447** **Pneumatic-engine control** systems shut down or warn when measured variables don't function properly. 60-p catalog J is offered by Fulton Sylphon Div, Roberthaw-Fulton Controls Co

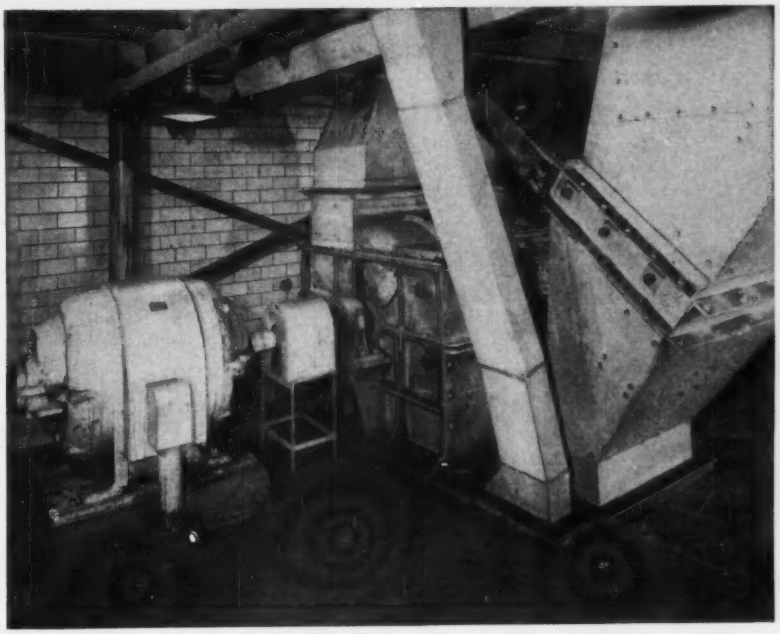
**448** **Supervisory Instrumentation** for industrial turbines is covered in 12-p bulletin GEZ-3078; 4-p brochure GEZ-3077 explains an exchange plan for these units. General Electric Company

**449** **Recovery of waste heat** from i-c engines is shown in 24-p article. J B Beaird Company, Inc

**450** **Fuel and oil additive** for prime mover and i-c engines is outlined in 6-p booklet. Lubrication Engineers, Inc

Just circle key numbers on the Reader Service card, page 197, to get your free design aids


# CRUSHING FACTS



## American "Rolling Ring" Coal Crusher
### *splits coal . . . smashes maintenance costs!*

In almost five years, the above American Coal Crusher has reduced 1,800,000 tons of 2" x 0" coal to a ¾" x 0" product for a prominent midwestern utility. Since installation, this unit has handled an average annual tonnage of 450,000, with a very low ratio of replacement parts to tonnage. The operating engineer for this utility says, "We have experienced no stoppages . . . crusher operation and maintenance have been very satisfactory."

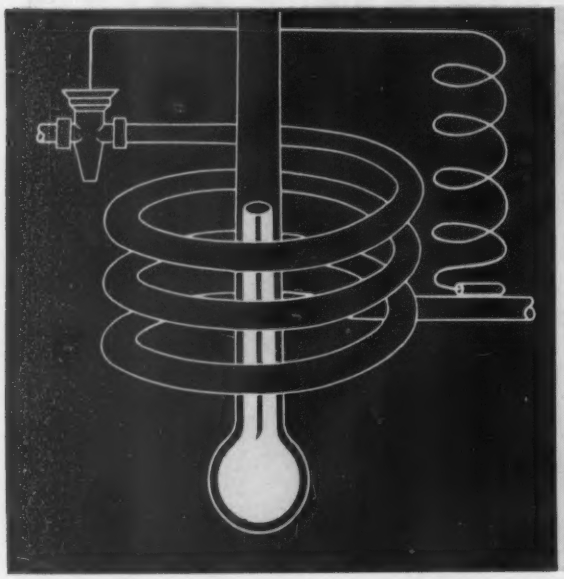
*"Rolling Ring" design makes the difference.* Specially designed rotor, consisting of four rows of patented shredder rings, each suspended on a single shaft, rotate freely at a relatively *slow speed.* Coal is *split* rather than smashed. This splitting action saves both power and maintenance, gives more uniform sizing, fewer fines. Rings can be reversed to give extended life.

American has manufactured reduction equipment since 1908 and you can be sure that "When you figure costs, the best results come from American *Rolling Ring* Crushers." If you have a coal preparation problem, why not write today for recommendations and literature. Our highly-trained engineering staff will give you prompt assistance.

American PULVERIZER COMPANY

1349 MACKLIND AVE. ST. LOUIS 10, MO.

# AIR-CONDITIONING SYSTEMS



The air-conditioning growth curve shows no sign of tapering off. Expansion potential is spurring development of more-efficient packaged equipment; a case in point is the high-speed centrifugal refrigerating machine recently introduced. This design has an excellent chance of changing the complexion of an area long dominated by packaged reciprocating machines.

Trend to centralized control of new a-c systems will continue at an even faster pace (see pp 79-81). Older systems will also benefit by centralizing controls and bringing them up to date. Many more plants will seriously consider the advantages of a center that groups *all* energy-systems controls at one location. This concept greatly simplifies plant operation in addition to cutting maintenance costs.

R H Franke

Associate Editor

## ● Air-conditioning and refrigeration equipment

**113** **Rooftop unit** separates cooling and heating—7½-hp unit has a total 75,900-Btu-per-hr cooling capacity; output of gas furnaces is 160,000 Btu. Two fans on common shaft, 1-hp fan motor and variable-pitch drive, filters and two 100,000-Btu-per-hr input-duct furnaces comprise heating section. Cooling section contains air-cooling condensing unit, evaporator coil and control box. It is precharged with refrigerant. Sections are prewired, mounted on 4-in.-channel iron frames and enclosed in aluminum panels. Removal of one panel gives access to fan, fan motor and drive, filters and burners. Supply and return air enter through single ceiling diffuser.—Westinghouse Electric Corporation

**114** **Heating, ventilating and a-c units** have blading similar to jet-engine aircraft. Sizes range from 12-in. dia in fixed-blade design to 12- to 120-in. dia in patented blade-retention design. Hub diameters: 14 to 40 in. Engineered drives include belt, coupling or direct drive.—Benson Manufacturing Company

**115** **Dryer-coolers adapt to any location.** They use vertical-f-d air flow and diagonally mounted coil sections for maximum heat rejection. This permits efficient operation regardless of prevailing air currents. Damper controls keep temperatures uniform during low ambient dry-bulb periods. You can dial the fluid temperature and hold the cold-fluid return temperature within close limits.—The Marley Company

**116** **Hermetic-refrigeration unit** goes through a standard doorway completely assembled. Packaged design is factory-piped and -insulated; it requires no auxiliary water and refrigeration piping or control-tube installation on job site. Eight sizes handle 50- to 100-ton refrigeration capacities, require less floor space. A liquid-refrigerant-cooled electric motor drives the centrifugal compressor at 18,000 rpm on 480-v 3-phase 300-c current. Refrigerant from condenser sump enters the l-p motor housing atmosphere; change of state from liquid to vapor at motor windings permits refrigerant to absorb all heat generated within the miniaturized motor.—American-Standard Industrial Div

**117** **Weatherized straight cooling units** and heat pumps in 8- to 10-ton range combine cooling with noise reduction. Sound energy in compressor shell is taken up in cooling the motor. Units start against any load, permitting the use of automatic-resetting high-pressure controls.—General Electric Company

**118** **Indirect-fired** portable space heater blows air around the outside of a completely enclosed combustion chamber, produces large volume of fresh air. Similar to an oil furnace, it produces 200,000-Btu heat at 1600 cu ft of warm air per min, or 420,000 Btu at 4500 cu ft of air. Fumes can be vented at top.—Stow Mfg Co

**119** **Finned-tube horizontal heater** weighing 170 lb can be installed singly or in banks. Helical aluminum fins lock tightly into pipe for good heat transfer. Two finned pipe sections welded together form one continuous length—single tube assures even distribution of steam, avoids cyclic stresses.—The Griscom-Russell Co

**120** **Axial-blade ventilators** come with fire-retardant all-fiberglass housings. Housings withstand physical and chemical abuse—weather, salt spray, fumes. Molded-in color never needs repainting. Other features: high efficiency, low cost.—Swartwout Fabricators, Inc

**121** **Factory-built screen units** and assemblies apply to almost any air-moving system. 452 sizes are listed, covering a range of 450 to 30,000 cfm. Modular design lets you select combinations to handle up to 80,000 cfm in one system.—CRS Industries Inc

**122** **Filter dust collector,** designed for service to 550 F, provides air-cloth ratios from 5 to 10 cu ft per sq ft. Reverse air cycle collapses bag. Nozzle in cap at top

releases pulses of air which induce a current from the top on down. Current flexes and opens collapsed tube and purges dust into hopper, getting rid of trapped dust without damaging fabric.—Dustex Corp

**123** **Dry type filter** has air-cleaning efficiencies to 97%. Filter inflates when ventilation system is in operation and collapses when system shuts down. It can be serviced from air-entering or air-leaving side of filter bank. Disposal filter has folding 8-lb cartridges. Rated at 2000 cfm, it provides 95-sq-ft media surface.—American Air Filter Company, Inc

**124** **Vertical discharge units** for replacing air removed by exhausts feature versatility—using standard components, these units do many kinds of jobs. Just add shutters, steam coil, filter house or diffusers to roof-ventilator-fan housing. Units have 4000- to 36,000-cfm, 380,000- to 2,642,000-Btu-per-hr range.—Hartzell Propeller Fan Co

**125** **For gas and fume disposal,** vapor inverter mounts on pressure-relief vent of a storage tank. Fumes and gases vented as product is pumped in are directed high into the air, protecting personnel in nearby ground areas. Inverter directs 80% or more of the vented fumes into the air at velocities from 13 to 25 mph. Units don't cut capacity of the relief vents, maker states. Sizes range from 2 to 12 in.—The Johnston & Jennings Co

**126** **Dual-function ventilation package** simplifies air handling, providing simultaneous supply and exhaust. Versatile fan handles general or industrial ventilation at temperatures to 2000 F. Heart of system: a single cast-aluminum fan wheel. Inner part of wheel circulates air in one direction, outer portion routes it in the opposite direction. Advantages: only one opening is needed. One motor, one drive, one starter are involved, cutting first and maintenance costs; installation time drops.—Clarage Fan Co

**127** **Steam-fired air-intake unit** replaces air removed by operation of exhaust systems, consists of single cabinet which houses a propeller fan and a steam coil. Four standard units provide 4000- to 36,000-cfm capacity range. Unit can be installed with or without filters and distribution ducts. If tempered air is not required, leave out the heating coil.—Hartzell Propeller Fan Co

**128** **Safety vent** for heat, smoke and explosion relief has large glass-fiber windows, saves buying and installing two separate pieces. Installation is entirely above the roof. Combination skylight-vent has a quick release chain for hand operation.—Swartwout Fabricators, Inc

**129** **Disposable filter** is an economical answer to most odor problems. Activated-charcoal-coated fiber strips assemble in disposable but sturdy paperboard frame. The lightweight filters, available in standard sizes with or without dust media, handle duty in forced-air ventilating systems.—Barnebey-Cheney Company

**130** **Fume and mist collector** has a 3-stage separator and filter system for its heart. Cyclonic action first separates 98% of the mist. Part is dried, the rest collects in a plastic receptacle. Remaining 2% mist goes through a filter cartridge made up of fiberglass and activated-carbon layers which collect by impingement and absorption. Filter element can be removed, recharged, then replaced, Three standard models cost $220, $320 and $440, range from 350 to 1200 cfm. You can hang them from the ceiling.—Chicago Air Filter Co

**131** **Adjustable suction-tube** assembly for unit dust collectors eliminates need for permanent ducts. Tube is flexible fabric hose supported by lightweight arms which pivot to any desired position. Available in 3- and 4-in. hose diameters, assembly rotates 360 deg and has up-and-down travel of almost 8 ft. It is equipped with a fixed dust nozzle. Tube-assembly price: $60.—Torit Mfg Co

**132** **Condensation-nuclei detector** gets its name because it detects these smog-forming particles. Its one part per 1000-trillion sensitivity may make more-effective air filters possible. Detector causes droplets to form around each nucleus. Nuclei then grow to microscopic size—large enough to scatter a light beam. Measured electronically, scattering indicates nuclei concentration in the man-made fog. Detector is not commercially available as yet.—General Electric Company

## • Air-conditioning and refrigeration design aids:

Circle key numbers on page 197

**451** **Cleaning** after a hermetic-motor burn-out on a-c or refrigeration system is topic of 4-p bulletin 40-10-1. Installation is diagramed. Sporlan Valve Company

**452** **Packaged air conditioners** are featured in 12-p bulletin 8825. Performance, engineering features are covered. American-Standard Industrial Div

**453** **Cooling towers,** single-, double-flow and modular design, are covered in 4-p pamphlet. Fiske Company

**454** **Air-conditioning units,** packaged central-station types, are detailed in 60-p book AC-100. Charts, graphs, tables aid selection. American Air Filter Co, Inc

**455** **Packaged liquid chiller** and accessories are topic of 4-p brochure. Curtis Mfg Company

**456** **Principles of refrigeration,** air-conditioning equipment are features of 32-p bulletin 80-F. A table of storage temperatures is included. Frick Company

**457** **Liquid chiller,** hermetically packaged, is described in 10-p illustrated bulletin 3926. Rated capacity tabulations and cooler and condenser pressure-drop charts are features. American-Standard Industrial Div

**458** **Motor compressors,** 4- and 6-cylinder units, are topics of 4-p brochures 6001 and 6006. Compressors extend low-temperature range to 7½ and 10 hp. Copeland Refrigeration Corp

**459** **Leak detection** for air-conditioning and refrigeration service is topic of 10-p bulletin GEA-6827A. Halogen leak detector and accessory equipment are featured. General Electric Company

**460** **Heating and ventilating** engineering catalog contains selection charts for steam and HW coils, fan-motor ratings and dimensional data in its 32 pp. Units described provide heating from

# *Compressed Air Data You should have about damage caused by Water, Vapors, Acid fumes and Abrasives in the Air System*

A study and discussion of compressed air and its inherent properties which cause corrosion, contamination, abrasion and freezing of pneumatic equipment are covered in 16-page brochure "*Moisture Control.*"

Now in its 26th printing, the brochure explains how the unique, low-cost Van-Air method extracts water. vapors, acid fumes and abrasives which normally flow past aftercooler and receiver—how these elements corrode pneumatic equipment and controls—damage products in process—contaminate exposed solutions.

The method (which operates for *less than ONE-CENT per 18,000 cu. ft.*) requires no heat or power—no regeneration—delivers air dry, clean, sterile and non-toxic. Now used in hundreds of different applications in all types of plants—large and small. The method can treat any volume of compressor output from minimal air for smallest instrument, gage, tool, etc. to total air for entire plant. It has no capacity limit. Ask for brochure—*free on request.*

**VAN PRODUCTS CO.• MFRS.**

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## Air-conditioning systems

Begins on page 252

47,000 to 2,990,000 Btu, air capacities of 1500 to 32,000 cfm. Carrier Air Conditioning Company

**461** **Unit heaters,** blast heaters, radiators are featured in 42-p catalog. Construction features, installations, specs and dimensions are detailed. Cutaways and diagrams aid selection. D J Murray Mfg Co

**462** **Low-pressure heating** of industrial buildings is discussed in 8-p brochure 649B. American-Standard Industrial Div

**463** **Heat-cycle defrost units** are described in 4-p bulletin. Specs and diagrams are included. Dunham-Bush, Inc

**464** **Fans for ventilating** and exhaust systems also handle temperatures to 2000 F and serve with pneumatic conveying systems. 6-p pamphlet is available from Garden City Fan & Blower Co

**465** **Aluminum brick-size vents** for unit air conditioners, boiler rooms and fuel-oil vents are described in 4-p booklet. Construction Specialties, Inc

**466** **Direct-drive** centrifugal roof ventilator is subject of 8-p bulletin 4104. Selection and rating tables and installation drawings are given. American-Standard Industrial Div

**467** **Exhaust** and ventilating fans are pictured in 4-p folder from Barry Blower Co

**468** **Fan-powered roof-ventilator** specifications are included in 16-p catalog A-112E. Vertical-discharge units and reversible ventilator which converts from exhaust to intake are covered. Hartzell Propeller Fan Company

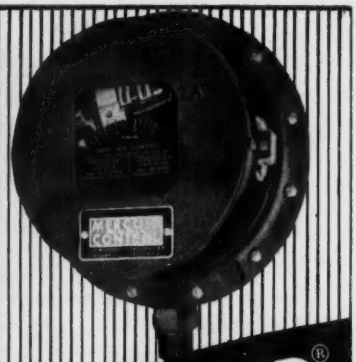
**469** **Panel type air filters** made of Dynel, 1- and 2-in. thick, are shown in 4-p bulletin A1. Union Carbide Development Company

**470** **Dust-collecting** and -recovery systems are covered in 4-p folder. Recovery of material from waste gases is one application. Buell Engineering Company, Inc

**471** **Dry type 4-lb air filter** has collapsible, disposable cartridge. 8-p bulletin 228 includes installation, operation and specs. American Air Filter Company, Inc

**472** **Panel,** grease, oil-bath and roll type filters are described in 4-p circular from Continental Air Filters Inc

**473** **Air filter** uses single sheet of synthetic plastic material, breaks air stream into little jets, traps dust and dirt. Story is in 4-p bulletin available from American Air Filter Co, Inc

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New low pressure diaphragm control for gases or air. Can be used three ways; for pressure, negative (vac.) pressure or differential pressure.

Two operating ranges, 1.0" to 30.0" and 1/2 to 5 psig.

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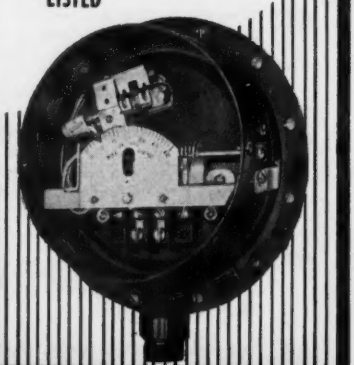

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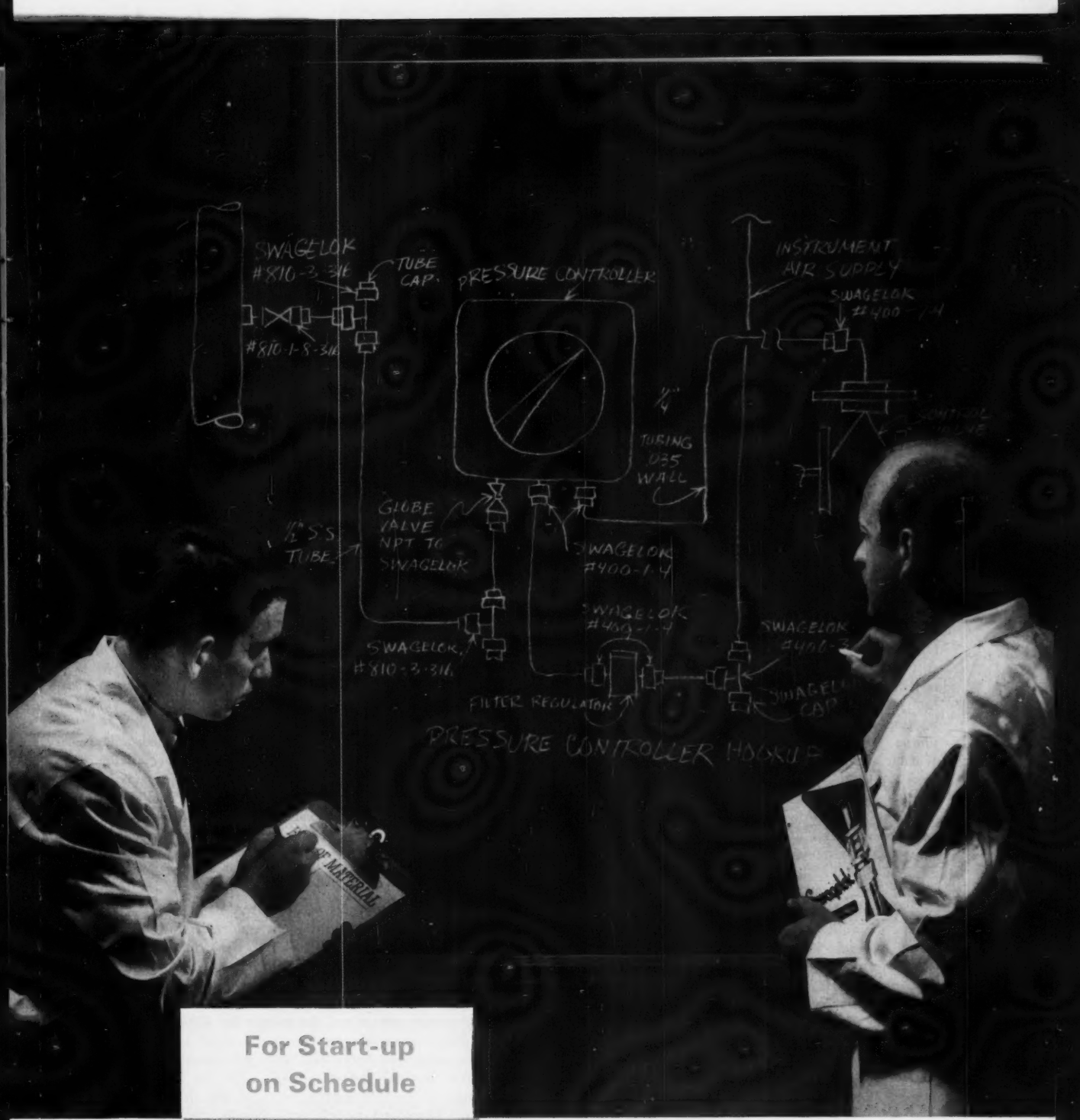
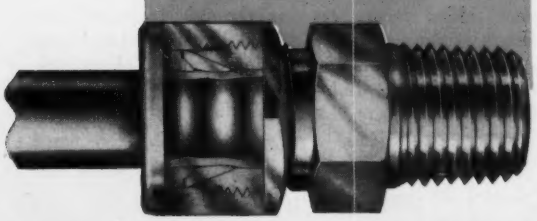



## For Start-up on Schedule

**Specify**

**Swagelok®**



### Don't Let Leaky Connections Cause Expensive Delay at Start-up

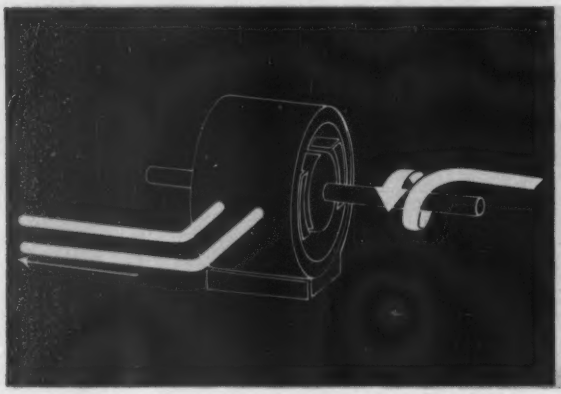
These engineers are specifying Swagelok for plant construction. The most severe test of tube fitting design and quality is in plant construction. Many plants have been built using 10,000 to 20,000 or more Swagelok tube connections without a leak. You can spend days to find one leak among the thousands of tube connections on a construction job.

**Insure plant start-up on schedule—specify Swagelok**

CRAWFORD FITTING COMPANY, 884 East 140th St., Cleveland 10, Ohio
CRAWFORD FITTINGS (Canada) LTD., Niagara Falls, Ontario, Canada

For more facts circle 928 on Reader Service card, p 197

Circle key numbers on Reader Service card, page 197, for more information



Interest continues high in emergency standby generation. There's no significant change in conventional units, but more designs are available in the uninterrupted-power category for central-station and industrial-control applications. (Next month's *TD* report will cover aspects of computer power supply.)

Field experience is confirming the importance of gas insulation for power and distribution transformers.

Norman Peach

Associate Editor

## ● Electric generation, transformation and conversion equipment

**133** **Heavy-duty electric generator** brings 3000-w packaged power to the job or to remote locations. Generator's secret: a permanent magnet alternator. Magnet's rotating field generates electric power with no brushes, slip rings or commutator. Permanent magnet is internally fan-cooled, corrosion-protected, connects directly to engine shaft with no coupling and no power-wasting belts. Rating: 115 to 230 v, 60 cycle, single phase. Unit is powered by gasoline engine.—Borg-Warner Corporation

**134** **Electric plant** is rated 85-kw standby, 75-kw continuous duty—available in all standard voltages for both gasoline and gas-fueled operation. Radiator or city-water-cooled models have remote or pushbutton starting. Unit has a 12-lead generator with direct-connected exciter. Engine is 8-cylinder V type, 168 hp at 1800 rpm. Standard equipment includes automatic voltage regulator, antidieseling device for gasoline models, electric-solenoid gas-shutoff valves for gas models, low oil-pressure and water-temperature cutouts.—Kohler Co

**135** **Electronic development** makes 110-v-ac power possible from 12-v storage battery. Use to operate electric hand tools, regular electric-light bulbs—anything that does not exceed unit's wattage output. Comes in four models from 150- to 500-w output.—The Electric Storage Battery Co

**136** **Three single-phase regulators** mount directly on 3-phase power transformer. Bypass switch is located above each regulator. Result—space is saved—you only need one concrete pad for mounting the entire assembly. Bypass switches have visible disconnect permitting regulators to be safety bypassed for periodic inspection without interrupting transformers.—Allis-Chalmers Mfg Co

**137** **Transformer section** of h-v power unit has full-wave rectified output of 100 kvp, 5 ma. It's convertible for negative or positive ground. Use for electrostatic spraying, dust precipitation and coating- and insulation-breakdown testing.—Century Coil Corporation

**138** **Transformers for high-current metering** and relaying on l-v systems come in single or double ratios. 600-v units have ratings of 800 to 4000 amp with 33 1/3 to 100% more overload capacity. They can be flush-mounted for a vertical bus coming through a platform or a horizontal bus extending through a wall. Dual-ratio units have 3- or 4-terminal arrangements. Primary opening is 5½ in. in diameter and takes a 4-in.-sq bus or multiple cables.—Westinghouse Electric Corporation

**139** **Stationary battery charger,** a silicon-controlled unit, replaces magnetic amplifier used as main regulator in battery chargers. Result: weight and size savings. Current limiting is provided in both "float" and "equalize" positions for overload protection to charger and battery. Units are short-circuit-proof. There are no moving parts, relays or electronic tubes.—Hughes Electronics Company

**140** **Universal insulating oil** features flash point 10-C higher than firm's previous transformer and circuit-breaker oils. 145-C flash point gives greater margin of safety. Compatible with previous oils, new oil has same uses.—Westinghouse Electric Corporation

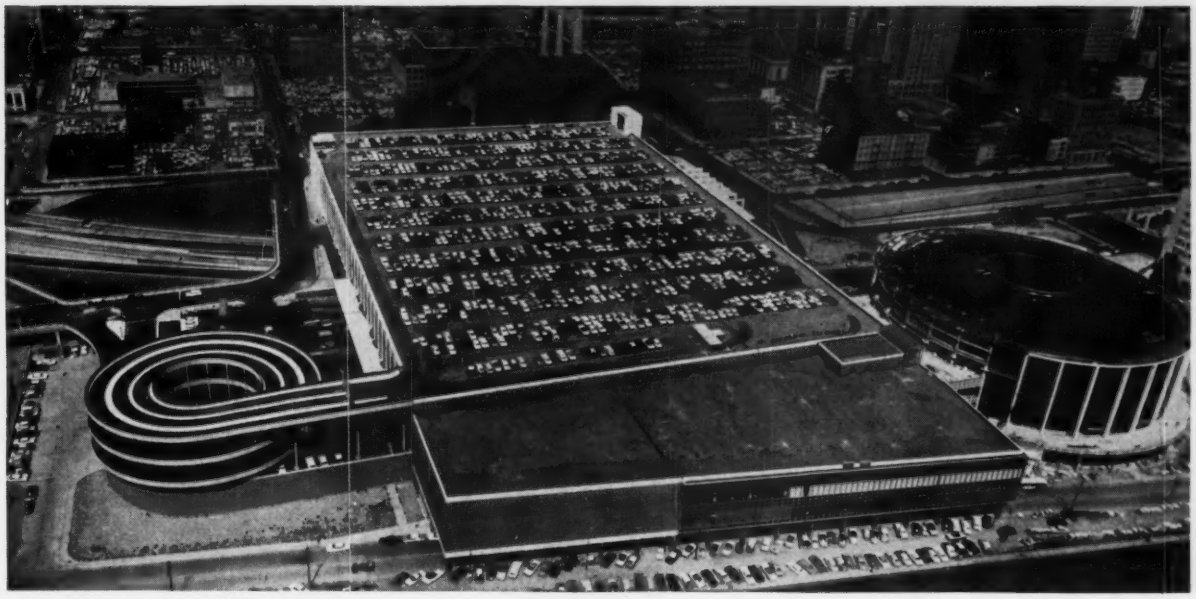
**141** **Automatic voltage regulators** are for 50/60-c 3-phase applications requiring constant output voltage with zero waveform distortion. Standard assembly ratings: 460-v nominal output voltage, 380- to 520-v input range, adjustable output range of 440 to 480 v. Re-entry rings and helical coils permit stepless voltage adjustment with low drop.—The Superior Electric Co

**142** **Voltage-sensitive** current-bias capacitor control has balance-beam regulating relay. Current pickup modifies straight on-off control. Capacitors are off during light loads, on during peaks. When preset current value is reached, shorting relay contact inserts a resistance in the regulating relay circuit. Voltage is decreased, which energizes the timer. Function is relayed, switching capacitors onto circuit. — Allis-Chalmers Mfg Company

**143** **Bandwidths** of ±¾ v are desirable because they produce added feeder revenue through increased line length or capacity. Now, voltage levels and bandwidth settings on manufacturer's single- and 3-phase step regulators can be dialed to desired levels, and regulators can be adjusted in ten sec.—General Electric Co

continued

# WHAT A HALL!



This is Cobo Hall, Detroit's new exhibition building—one of the largest of its kind in the world. The structure is three stories high and has 51 acres of floor space. Inside, there are 32 meeting rooms, a cafeteria, a coffee shop, a banquet hall that doubles as a ballroom and four huge exhibition areas—one area has about 300,000 square feet of exhibit space. ☐ The Hall is so big that they used 330 tons of USS NATIONAL butt-welded and seamless pipe in sizes ½" through 24" O.D. just for the heating and air conditioning systems. They run steam through the heating system at 300 °F. and 35 psi. The air conditioning (system) can carry 10,000 gallons of water a minute at 65 psi. ☐ When you need quality pipe and tubes for power, heating and air conditioning installations—order USS NATIONAL. For information or technical assistance, write National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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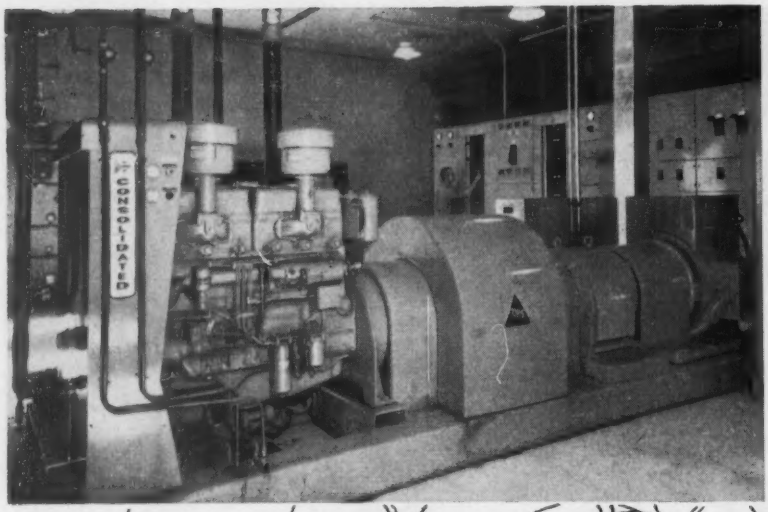


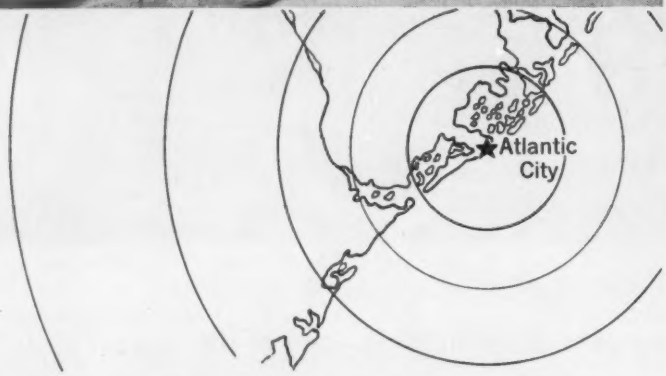


## Condec UPS Selected by FAA for Use in New Experimental Air Traffic System

A new concept of air traffic control is now being tested by the Federal Aviation Agency in an experimental electronic system installed in Atlantic City. With flight plans for planes aloft over the United States or enroute to the United States stored in its mammoth memory, the computer system constantly analyzes and updates position reports to warn of collision possibilities.

At jet speeds the pattern changes with such rapidity that even a few seconds' loss of power is intolerable. Because the Condec Uninterrupted Power Supply eliminates power outages when commercial power fails, it has been chosen by the FAA to participate in the test.

If power loss for a few seconds or even microseconds can spell calamity in your operation, a Condec Uninterrupted Power Supply may be your cheapest form of insurance. It prevents power outages entirely.

For full information, write or call Mr. Frank Cesario, DAvis 5-2261, DDD Code 203.

**Uninterrupted Power Supplies**

Condec Uninterrupted Power Supply is a complete, packaged system for assuring absolute continuity of electrical power.

- two types — single dynamo and motor-generator
- 5 to 200 kw capacity
- full power without interruption to load
- maintains voltage within 2%; eliminates voltage regulators at load
- frequency maintained within 3.5% during transition

POWER EQUIPMENT DIVISION

**CONSOLIDATED DIESEL ELECTRIC CORPORATION**

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## Electric generation

**144** **Sealed silver-cadmium cells** are being evaluated as replacements for nickel-cadmium batteries in solar-cell accessory power systems. They may allow operation at greater depths of discharge and higher charging rates, for important weight savings. — Yardney Electric Corporation

## • Electric generation, transformation and conversion design aids

**474** **Substation transformers,** liquid filled, are topic of 18-p bulletin 5800-1A. Range for single- and 3-phase models is 501 to 10,000 kva and up to 69 kv. I-T-E Circuit Breaker Co

**475** **Ventilated dry type transformer** specs: found in 8-p catalog 162. Units are rated from 600 v and below to 15,000 v; from 3 to 2000 kva. Niagara Transformer Corp

**476** **Dry type transformers** are covered with prices, dimensions, specs in 24-p brochure GEA-6907A. Single- and 3-phase general-purpose and voltage-stabilizing transformers are included. General Electric Company

**477** **Single- and 3-phase** dry type transformers are detailed in 36-p catalog. Wiring diagrams, specs and prices are given. Atlantic Transformer Company

**478** **Large distribution transformers,** single- and 3-phase units, are described in 12-p catalog GEA-7153. Weight and dimension tables included. General Electric Company

**479** **Dry type transformers** rated ¼ to 10,000 kva, are topic of 8-p bulletin. Sorgel Electric Company

**480** **Single- and 3-phase transformers,** ventilated indoor dry type, are covered in 8-p bulletin 160. Niagara Transformer Corp

**481** **Electrical insulating oils** for transformers and cables are detailed in 8-p bulletin 58. Sun Oil Company

**482** **"Standby electric plants** and controls—a guide to their selection and installation" is title of 8-p folder from D W Onan & Sons Inc

**483** **Frequency converters,** 60 to 400 cycles, are subject of 16-p brochure SR 12.1—line diagrams included. Kearfott Div, General Precision Inc

Begins on page 256

**765** **Packaged emergency system** for uninterrupted power supply resembles diesel-generator set in appearance but differs in performance. Story is in booklet available from Consolidated Diesel Electric Corp

**766** **Brushless** inductor motor-generator makes 400-c power available for wide use. Specifications are in 4-p catalog from Leach Corp

**767** **Generating systems** in 10- to 200-kw range are topic of 8-p bulletin P-1. Standby sets are covered. Consolidated Diesel Electric Corp, Power Equipment Div

**768** **Emergency - generator** selection is topic of 4-p reprint. System, fuel type and transfer control are preinstallation factors. Onan Div, Studebaker-Packard Corp

**769** **Dc and ac power supplies** including rectifier devices are illustrated in 16-p pictorial report published by A O Smith Corporation

**770** **Power system** maintains regulated ac for distribution system and assures minimum voltage dip on motor starting across line. See 8-p bulletin 45-200 from Electric Products Company

**771** **Dc power-supply** 24-p handbook shows how to figure packaging dimensions for multiple dc outputs. Dressen-Barnes Electronics Corporation

**772** **Generator controls** and transfer switches are topics of 4-p circular 1260. Auxiliary controls are shown. Lake Shore Electric Corp

**773** **Medium transformers** and their insulation system: explained in 24-p bulletin GEA-6108D. Gives kva and voltage ratings for 501- to 5000-kva single-phase and 501- to 10,000-kva 3-phase units. General Electric Company

**774** **Rebuilding** distribution transformers is subject of 8-p brochure GEA-7108. Life span of transformers is charted and insulation system described. General Electric Company

**775** **Dry type transformers** rated 3 to 50 kva, single phase, are outlined in 4-p brochure 61B8222B available from Allis - Chalmers Mfg Company

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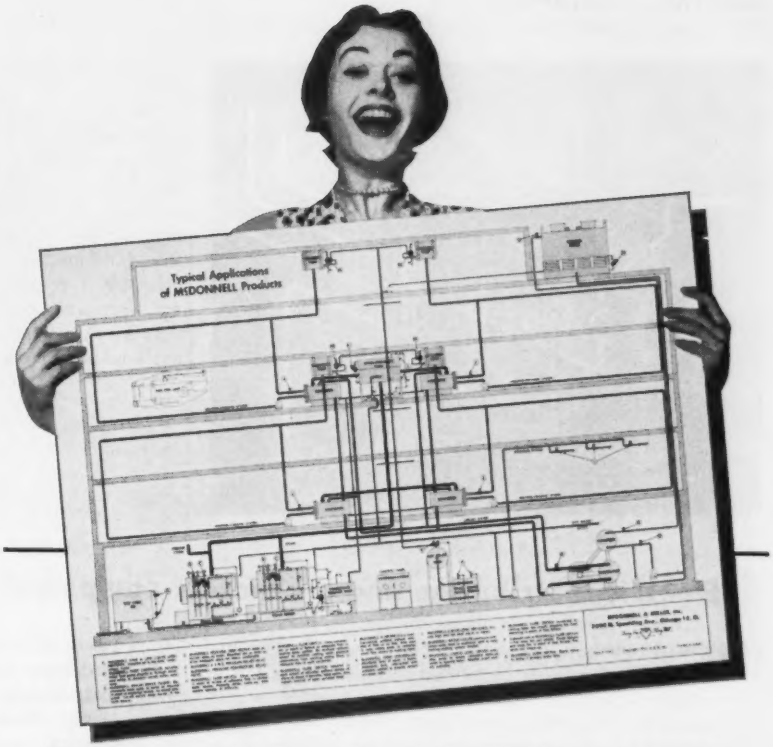
**Power supply** for computers comes under discussion in next month's *TD* report: what problems can be traced to power supplies, what energy-systems engineers can do about them.


# Your kind of Pin-up!

## *It shows where and why you use McDonnell products*

Here is a wall chart that does an excellent job of pointing out the application of McDonnell controls in a typical commercial building.

It's yours for the asking. The gal isn't included; her only purpose is to show you that it is a big, three-foot-wide, easy-to-read chart, printed in four colors to illustrate the applications on boilers, tanks, heaters, chillers, fan coils, cooling towers and other equipment.

Uses of major McDonnell products are shown and described: boiler water feeders, pump controllers, tank feeders, relief valves, liquid level switches, and flow switches.

Unless we're both lucky you won't find all of these uses in any one building. But you'll find many of them—probably more than you'd think—in most buildings. Just mail the coupon to receive your chart by return mail.

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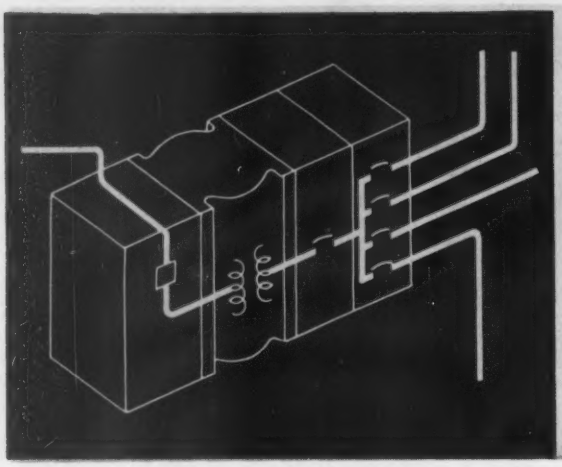


In the h-v bracket, especially 138-kv and up, one U.S. manufacturer offers an air-blast circuit breaker competitive with oil. Although this is an original design, the type is popular in Canada and Europe, and may well give the large oil breaker a run for its money now that it's here. At 600 v and below, the current-limiting fuse continues as the center of new designs. Already established as protection for motor starters and back-up for molded-case breakers, c-l fuses are now used with l-v power (air-magnetic) breakers and with draw-out load-interrupter switches.

Norman Peach

Associate Editor

## Electric distribution and protection equipment designs

**145** **Fused switch** is designed to use current-limiting and overload characteristics of dual-element fuses for l-v feeders with fault capabilities up to 100,000-amp symmetrical. You get full fault protection economically on feeders with relatively low continuous-current ratings, high short-circuit current. Rating has been fully tested. —Pennsylvania Transformer Div of McGraw-Edison Co

**146** **Disconnect switch** comes in both single-throw and double-throw designs, suitable for 750-v operation. Apply it for gang operation in multiples of 5000 amp. Unit works effectively in a differential tinning line where switches bolt directly into buswork without other means of support.—H K Porter Company, Inc

**147** **Explosionproof plugs** and receptacles permit safe, rapid connections for electric lighting and power distribution. They can be used with 2-, 3- or 4-wire circuits rated up to 240 v, 15 amp or 120 v, 30 amp. Electric-grade copper contacts are encased in neoprene bodies. Design prevents possibility of a spark igniting an explosive atmosphere—lip on plug fits into a collar on receptacle to form a sealed chamber. Only then can plug be turned to complete circuit.—J B Nottingham & Company, Inc

**148** **Stab with inverted hairpin design** is said to exert more than normal 60-lb pressure when carrying heavy inrush or short-circuit currents. Rated to 400 amp continuous, unit has a variety of applications but is best for heavy duty. Install in all kinds of current take-off devices — safety switches, circuit breakers, plug-in cable tap boxes and panelboards which mount directly on the duct.—Federal Pacific Electric Co

**149** **Drawout switchgear** gives premium design and safety to subs. Custom-tailored l-v switchgear, part of a load-center unit sub, has greater reliability, convenience and operator safety than conventional equipment, according to maker. For utility generating stations using 600-v ac and below, Powermaster protects against short-circuit spreading which could lead to costly downtime. All controls, including fuses in dead-front fuse holders, are accessible from the front. Control power transformer, potential transformer and associated fuses mount in a separate auxiliary compartment in front and are easily removed. Racking mechanism lets you rack breakers to "connected," "test" or "disconnect" with compartment door closed. For extra safety, positive interlocks prevent inserting or withdrawing closed breaker.—General Electric Company

**150** **Electric operators** are for h-v metalclad fused-load-interrupter switchgear for 4.8- to 14.4-kv switching centers, substation primaries, secondaries and service entrances. They use a motor-operated worm-driven gear head powered by control circuits of 12-, 48-, 125- or 250-v dc or 12- or 240-v ac.—S&C Electric Company

**151** **Pressure and differential-pressure switches** now handle up to 250 psi with no damage or leakage. Pressure acts on a spring-biased diaphragm. A magnet, mounted on the diaphragm, transmits motion to the actuating mechanism through a metal wall, avoiding sealing problems and isolating the electrical mechanism from the fluid. Switches cover an actuation range from 0.125- to 16-psi differential.—Pall Corporation

**152** **Pushbutton switches** designed for low-cost stop-lock-out protection feature sliding latches that you can padlock. Use them on conveyor systems, automation lines, machine tools—with multiple motor drives or where controls are isolated from drives. Maintenance man stops any one motor. Then, once he has padlocked the latch to keep the control circuit open, he can make repairs in safety.—Mackworth G Rees, Inc

**153** **Rotary 20-amp switch** rated 600-v ac carries four isolated double-break silver-alloy contacts in each stage. Modular design lets you use up to 48 contacts in minimum switch length of 12 stages. A double cam, arranged like a sandwich within the stage, operates contacts.—American Solenoid Co, Inc

**154** **L-v switchgear** features Power-to-Grow—it's uprated to meet modern electric-system requirements. FP-500 series offers increased-frame-size breakers in continuous-current ratings of 400, 800 and 2000 amp; FP-100

series offers two frame sizes in 3000- and 4000-amp ratings at 600 v. Uprated frames allow greater load growth with a given size. Raising interrupting capacities of FP-500 units to 50,000-amp asymmetrical and FP-100 to 100,000 amp gives user advantages of fully rated system at prices of a cascade system. FP-500 series breakers can mount four-high; compartment of 2000-amp breaker will accommodate smaller-frame-size units for future uprating. Tripping device is adjustable to new load requirements.—Federal Pacific Electric Company

**155** **Motor operators** used with circuit breakers assure continuous electric service. If normal power is lost, automatic-transfer control system senses loss, starts up a 75-kw diesel-engine generator. When generator voltage reaches proper level, "normal" breaker opens and "emergency" closes to restore power to the building. When normal power comes back on the line, "emergency" breaker opens, "normal" closes after 2-sec time delay. Unit is rated 70 to 800 amp, to 600-v ac and 250-v dc.—I-T-E Circuit Breaker Company

**156** **L-v current-limiting breakers** protect against fault currents to 200,000 amp. In a single switchgear compartment, circuit breaker integrates high-capacity current-limiting fuses, protective features of stored-energy breakers, device preventing single phasing. According to maker, current-limiting insurance doesn't sacrifice breaker's ability to adjust smoothly for overcurrent and short-circuit tripping. Application possibilities: replacing existing breakers when available short circuits exceed breaker interrupting capacity because of system expansion; protecting panelboards with limited interrupting capacity; protecting l-v bus duct, other load-side equipment with limited short-circuit-withstand capacity.—I-T-E Circuit Breaker Company

**157** **100-amp molded-case** plug- or bolt-in breakers cut mounting-space requirements up to 2/3 for commercial or light industrial applications. Height: under 3 in. The 2-pole unit is 2-in., the 3-pole breaker 3-in. wide. Handles run full width of the breaker, spanning all its poles—extra gripping area for easy manual operation, and a sure guide during panelboard installation to tell which handle works which pole.—I-T-E Circuit Breaker Company

**158** **H-v motor control** for 2000- to 5000-v range is two "stories" high—one controller mounts on top of the other. Each has a full rating of up to 1750-hp maximum at 2300 v or 3000-hp maximum at 4000 to 5000 v; each has interrupting capacity of 150 mva at 2300 v or 250 mva at 4000 to 5000 v with current-limiting fuses. Reasons behind this design innovation: heart of the equipment, an air-break contactor, uses new glass-polyester insulations replacing sheet metal wherever possible. Superior insulating characteristics allow reduced space requirements. Insulation cuts size of contactor rated 400 amp, 5 kv, 50 mva to only 28 x 16 x 24 in. According to maker, insulation is flame-retardant and nontracking, should extend control's life.—Allis-Chalmers Mfg Company

**159** **Motor starters, contactors** are nonreversing. They're designed for full-voltage starting of 1/6- to 2-hp squirrel-cage motors. You can use same unit on either single- or 3-phase motors operating on 110 to 600 v and 25 to 60 c. Enclosures are available for separate pushbutton operation, "hands-off-automatic" selector switch or with start-stop pushbutton.—The Clark Controller Company

**160** **Size-00 motor starter** features accessible contacts—no tools at all are needed to remove movable contacts, which snap in and out. A screwdriver will remove stationary contacts. Rated two hp, starter handles low-load applications—compressors, pumps, blowers, conveyors. Straight-line vertical operation cuts danger of accidental closing.—Federal Pacific Electric Co

**161** **Combination starter** is designed for safety. Double-door dead-front construction makes unauthorized entry a tough proposition. For maintenance, main door can be opened with a screwdriver—with disconnect switch or circuit breaker off. But another screw must be turned if disconnect or breaker is on. Once main door is open, you have to depress a defeater mechanism to turn breaker on. Operating handle can be padlocked off but not on. Components: magnetic starter, control transformer and branch-circuit protective device.—General Electric Company

**162** **Contactors are mechanically held** in open or closed position; they don't hum and are not affected by line fluctuations. Molded-epoxy cell resists moisture and keeps the insulation from deteriorating. Low inrush currents to coil give greater flexibility for electrical-system design. Control circuits can be longer and more contactors can be put on one line. Because they handle less inrush current, devices have a longer service life. Extended bus bars make for easy installation in panels and switchboards. Mechanically held contactors are available in 30-, 75- and 100-amp sizes and are rated to 600-v ac line voltage on noninductive loads; maximum lighting load is 277 v.—Zenith Electric Company

**163** **"Slim-Jim" power capacitors,** 50 and 100 kvar, are rated 2400 to 7960 v, 60 c, single phase. Use single- or double-bushing units in sub stack racks on utility transmission and distribution systems. The 50-kvar unit weighs 92 lb. Its case is 15½-in. wide, only 4½-in. deep. The 100-kvar unit weighs 175 lb, is 13½-in. wide, 4½-in. deep and 41½-in. high.—Federal Pacific Electric Company

**164** **Pulling elbows** for hazardous wiring areas are explosionproof and dust-tight. Rollers at ends of chamfered wiring chamber reduce friction when conductor is drawn through hub, eliminating insulation damage. Elbows in 2½- to 4-in. sizes are of malleable iron.—Appleton Electric Company

**165** **Medium-capacity current-collector** system handles load-current requirements not needing high-capacity intergrated systems. Use for all types of ac and dc collection—traveling cranes, materials-handling units. Insulators, hangers, conductors, collectors are integrated as a package, ready for mounting on a building wall.—H K Porter Company, Inc

**166** **Silicone-base grease** is designed to protect insulators from effects of atmospheric-contamination deposits.

continued

Previously applied by hand methods, grease is now sprayed at any desired thickness. To prevent electrolyte formation in fog or rain, coating engulfs contaminant particles. It provides a nonwetting surface to shed moisture. When grease becomes saturated with contaminants and leakage and arcing begin, it breaks down into vapor and white silica powder to maintain high-resistance surface.—General Electric Co

**167** **Fittings** for ends of underground thermoplastic pipe conduits make it easier to insert power cables. Fittings are of plastic to match piping. Bell-shaped end flares to about twice OD of pipe; other end is normal pipe size and you couple it to runs of plastic pipe guarding lines against corrosion.—Tube Turns Plastics Inc

**168** **Control cable** with chemically crosslinked polyethylene insulation is for general use in air, conduit, underground ducts or for direct burial. Thermosetting insulation combines electrical with thermal properties. Cable can be spliced and terminated like any other thermosetting type. Available in 600- or 1000-v rating with two to 12 conductors.—General Electric Co

**169** **Panel enclosures,** NEMA type 12, are designed to house electrical controls, for use as terminal boxes, to enclose machine-tool wiring and for other applications. Units give complete protection from dirt, oil, water and coolants. They're made of heavy-gage sheet steel and are waterproof.—Keystone Mfg Co

**170** **Cable cutter** is powered by own hydraulic pump, useful where an outside power source is not handy. Fast-acting pump forces hydraulic fluid through h-p hose to ram assembly, delivering 25,000-psi to drop-forged cutting blades. Two models cut copper and aluminum communication cable (not ACSR) up to 3-in. OD. Safety features: one man can work the pump at street level while another makes the cut underground.—H K Porter, Inc

**171** **Quick-disconnect brush-terminal-assembly clip** is straight, its counterpart has a 90-deg bend. With new straight design two spade terminals can be inserted in one clip, so extra clips aren't needed in some installations. For minimum electrical resistance, clips are made of silver-plated beryllium copper and spade terminals of silver-plated copper. Assemblies can carry a continous current of 150 amp.—National Carbon Co

## Testing instruments

**172** **Multirange, portable dc voltmeter** has analog-to-analog conversion system; tape-slidewire potentiometer with 144-in.-long resistance element is calibrated and geared to an in-line counter for readout accuracy to 0.1% in normal ambient.—The Kotula Co, Inc

**173** **H-v-ac tester** is designed for proof tests, troubleshooting and preventive-maintenance programs on electric-distribution systems and equipment. Unit tests insulation breakdown in large motors and generators, transformers, switchgear, bushings. Models come with outputs up to 20 kv at 10 kva and 30 kv at 5 kva, larger ratings available. You can vary output continuously from zero to maximum through a 10-ft shielded cable.—Associated Research, Inc

**174** **Cable-phasing test set** is a labor-saver for reliable phase or conductor identification on underground systems, while keeping safety standards high. In the manhole, you connect all three conductors to ground after they have been exposed, clamp detector around each ground consecutively. Safety grounds ahead of work location are left in place. Pointer deflects in one direction for A phase, opposite for B, doesn't move for C. Dual-source transmitter operates from 60-c supply or dry cells.—James G Biddle Co

**175** **Pocket-sized Megger** insulation tester is always ready for immediate use. Its hand generator provides steady testing voltage with no batteries. Three ranges are available: 100-v dc, 0.02 to 20 megohms; 250-v dc, 0.05 to 50 megohms; 500-v dc, 0.1 to 100 megohms.—James G Biddle Co

**176** **Dielectric test set** has motorized, continuously adjustable output of 0-to-15 kv and 2-kva capacity. Dual-scale kv meter is connected directly at output for accurate voltage indication; motorized output control gives uniform measure of output-voltage rate of rise.—Peschel Electronics, Inc

**177** **H-v insulation tester,** portable and nondestructive, has continuously adjustable output of 0- to 500-v rms, features calibrated transistorized h-v circuit breaker. Use for manual, foot-switch or high-speed remote-control operation. You can reset manually or automatically after a leakage overload.—Opad Electric Company

## Electric distribution and protection design aids

Card on p 197 brings your copies

**484** **EHV products** and test programs are illustrated in 8-p booklet. Controlling corona power losses, eliminating stress-caused conductor and line slapping damage are covered. Booklet is available from Preformed Line Products Co

**485** **Trolley-busway** steel-enclosed electrification system is subject of 40-p bulletin 90. Special sections are included on installation planning, methods of mounting and application. Feedrail Corp

**486** **High-frequency bus duct** is featured in 12-p booklet 30-663. Covers application data, drawings, dimensions, specs. Westinghouse Electric Corporation

**487** **Steel-enclosed trolley busway** system bulletin 85 includes installation planning and procedure in its 44 pp. Feedrail Corporation

**488** **L-v distribution equipment** is covered in 92-p buying catalog GEC-1100C. Provides specs on safety switches, current-limiting fuses, circuit breakers, motor-control and power-distribution centers, panelboards and busway. General Electric Company

**489** **Planning** industrial power-distribution systems for safety, reliability and economy is discussed in 48-p bulletin GEA-7139. General Electric Company

**490** **Trolley busway distribution** systems for heavy duty are cata-

loged in 32-p brochure 80. Systems for electrifying cranes, hoists, conveyor lines are rated 225, 375 and 500 amp. Feedrail Corporation

**491** **Circuit breakers,** 1-v current-limiting units with 200,000-amp interrupting capacity, are detailed in 10-p catalog 4300-1A. Includes selection, application and guide specs. I-T-E Circuit Breaker Company

**492** **Oil circuit breakers** with 23-, 34.5-, 46- and 69-kv ratings are covered with drawings and photos in 16-p bulletin 7213. Federal Pacific Electric Co

**493** **Outdoor oil circuit breakers** feature cross-blast interrupter to reduce arcing time, cut carbon and oil contamination; available in ratings of 23 to 46 kv, 500 to 1500 mva. See bulletin 71B8475 available from the Allis-Chalmers Mfg Company

**494** **National Electrical Code** and conduit applications in hazardous locations are topics of 60-p catalog 2722. Crouse-Hinds Company

**495** **"Condulets** for corrosive locations" is title of 20-p bulletin 2609. Corrosive substances are listed in tabular form. Crouse-Hinds Co

**496** **Die-cast-aluminum conduit** made in both copper-free and copper-bearing aluminum are outlined in bulletins 657, 658. The Pyle-National Company

**497** **Conduit,** cable seals, insulating bushings, cable supports and terminators are cataloged in bulletin A-460. The Adalet Mfg Co

**498** **Wiring-installation equipment** is featured in 16-p catalog 159-D. Covers wireways, fittings, enclosures designed to JIC, NEMA standards. Keystone Mfg Co

**499** **Silicone-insulated cable** 4-p bulletin illustrates power and lighting cable, hookup wire and conductor cable for nuclear power purposes. Second 4-p bulletin outlines silicone-rubber-cable application case histories. Boston Insulated Wire and Cable Co

**500** **Cable-suspension system** is topic of 4-p catalog. Sheathing may be placed in tension. Perfect-Line Mfg Corporation

**501** **Cables use butyl-base insulation** that resists ozone, heat and moisture—described in 22-p booklet 1131. The Okonite Company

**502** **100-amp bus duct** is described in 8-p brochure. Pictures construction and standard fittings. Westinghouse Electric Corporation, Standard Control Div

**503** **Wire and cable** insulated with silicone rubber are specified with data charts and graphs in booklet from Dow Corning Corp

**504** **Current-limiting** power fuses rated 600 to 34,500 v are detailed in 8-p booklet. Components and mounting arrangements are featured. General Electric Company

**505** **Current-limiting** and concrete-cast reactors for distribution systems rated 34.5 kv and below are described in 16-p catalog GEA-976E. General Electric Company

**506** **Current-limiting fuses** for short-circuit and overcurrent protection are feature of 8-p bulletin GEA-6319D. General Electric Co

**507** **Fuse panels,** service-entrance equipment and switches are covered in 20-p publication PL 12-29-660. American Electric Switch Div of Clark Controller Co

**508** **Motor center** for controlling two or more motors from one location is topic of 8-p catolog. Unit is permanently wired to vertical cable bus for safety. Rowan Controller Company

**509** **Power-control-panel** specs are given in 16-p bulletin GET-3041. Squirrel-cage, synchronous-motor and wound-rotor-motor starters, incoming line, feeder-circuit and secondary breakers are detailed. General Electric Co

**510** **Operating and safety** requirements of service-entrance equipment are detailed in 6-p bulletin 601. Chapters on current-carrying efficiency, manual-switching facility and speed and capacity of s-c interruption are included. Pringle Electrical Mfg Co, Inc

**511** **Metalclad switchgear** is topic of two bulletins. 42-p GEA-5664F provides specifications for units in 2.4- to 13.8-kv and 75- to 1000-mva range. Installation of outdoor switchgear enclosures is detailed in 8-p GEA-7190. General Electric Company

**512** **Integral distribution centers** with liquid-filled and dry type transformers, 300 kva and up, are subject of 24-p catalog GEA-7222. General Electric Company

**513** **Compact substation** 6-p folder 61B9756 lists unitized components. Structural members are punched so additional high- and low-voltage bays can be bolted on. Allis-Chalmers Mfg Company

**514** **Dry type** integral distribution centers are discussed in 20-p catalog GEA-6928A. Centers for applications up to 5000 v are illustrated with ratings, dimensions, weights and list prices. General Electric Company

**515** **Secondary-control switchboards** with basic circuits—dimensions and components—are topic of 24-p well-illustrated brochure GED-4239. Describes applications for unit generator, transformer and power-transformer circuits. General Electric Company

**516** **Hp rated** heavy-duty metal-cased and double-break switches are listed in catalog 30-1. 16 pp include NEMA definitions of precision snap-acting switch terms. Unimax Switch Div, The W L Maxson Corporation

**517** **Modular-designed** rotary switches, hp rated for motor control are topic of 4-p brochure. Switches can be supplied in ratings from 20 to 200 amp. American Solenoid Company, Inc

**518** **4160-v metalclad** switchgear is topic of 20-p brochure 2801-2A. Indoor, outdoor and walk-in types are described, design, construction, performance features explained. I-T-E Circuit Breaker Co

**519** **600-v switchgear** with circuit breakers are described in 20-p bulletin 3200-1A. Provides information on breakers and switchboards from 225 to 4000 amp. I-T-E Circuit Breaker Company

**520** **Interrupter switch,** fused type for 600-v with capacities as high as 100,000-rms symmetrical amp, is featured in 8-p well-illustrated bulletin 100 available from Pennsylvania Transformer Div of McGraw-Edison Company

**521** **Snap-acting switches** for control and indicating circuits, firm's complete line, are described and illustrated in 32-p brochure 10-1—dimension drawings, force and movement specs included. Unimax Switch Div of The W L Maxson Corp

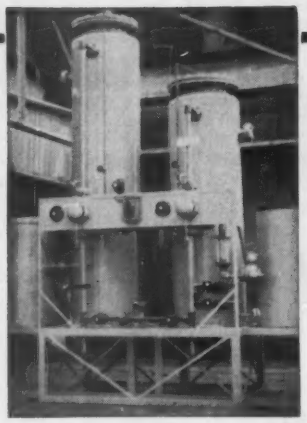
## Test instruments

**522** **Insulation testers,** 500 and 1000 v, are hand-, rectifier- and dual-operated. 14-p bulletin 21-45-23 gives details. James G Biddle Co

**523** **"High-voltage testing:** it can be nondestructive" is title of 4-p reprint 5-15.4. Insulation breakdown and current-limiting as a prevention measure are discussed. Associated Research, Inc

**524** **Dielectric-breakdown sets,** heavy duty and portable, are among instruments for testing electrical equipment in 12-p catalog 10-1.3. Associated Research, Inc

**525** **H-v test sets**—insulating-oil and multiple-output dielectric, ac-dc, 150-kv and 15-kva ac—are listed in 8-p catalog. Peschel Electronics, Inc



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Low-Cost • High-Performance
"PACKAGE" DEMINERALIZERS!
TWO-BED and UN-A-BED
STANDARD UNITS
NOW AVAILABLE!!

Unless *special* conditions require you to use a *special* demineralizing system, you can save big money—and get excellent results—with the new H&T Standard "PACKAGE" DEMINERALIZER! Into these superior Standard Units, we've put the experience of 16 years in building many hundreds of manual and automatic demineralizing systems. *Result:* H&T "PACKAGE" DEMINERALIZERS are masterpieces of design and construction—unequalled in performance and wonderfully low in cost.

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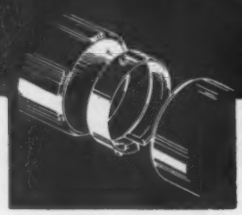
CLAYTON 3, NEW JERSEY

For more facts circle 932 on Reader Service card, p 197

ROBVON
BACKING RINGS



ROBVON BACKING RINGS APPROVED FOR WELDING PIPE, VALVES AND FITTING JOINTS

Robvon's Commercial Backing Rings are designed for quick easy alignment of pipe or tubing and assure precise close tolerance fit-up. Robvon Backing Rings allow complete penetration and fusion of the weld. Robvon Backing Rings radiograph perfect certified welds. The patented nubs automatically set the welding gap for the root-pass. The internal bevel and flat inner land assures non-restricted fluid flow.

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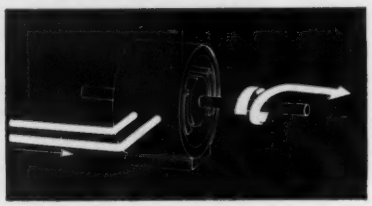
For more facts circle 933 on Reader Service card, p 197


## ● Electric application



Electric process heating forges ahead, both in kinds of applications and in technology. Resistance, induction and dielectric methods are replacing steam or gas-flame heat techniques. Infrared radiation, as well, has been adapted to many new processes.

Motor-design trends of recent years continue: further refinements and evaluation of insulating systems bases on synthetic resins and silicone rubber; increasing interest in imbedded temperature detectors for winding protection; expanded need for adjustable-speed drives.

Norman Peach

Associate Editor

## ● Equipment

**178** **Motor and gear-reducer package** comes in all ratings from ½ to 50 hp. Each unit is available as a "standard" with good selection of drive motors. Use wherever machinery needs a low-speed high-torque output. Typical drive motors: fluid shaft, wound-rotor slip ring, squirrel cage, drip-proof or totally enclosed.—Reuland Electric Company

**179** **Gearmotor** for materials handling also replaces air, hydraulic or steam cylinders and produces linear motion. Manufacturer guarantees package won't burn out for one year—electric motor's protective elements are connected in a warning system which removes motor from power source when temperature goes too high. High-torque and -slip intermittent-rated motor has an oversized magnetic disk brake. Crank on the output shaft is machined to receive cams which in turn actuate limit switches mounted on upper part of gear housing. Adjust cams and limit switches and crank pin stops at any position around-the-clock. — Westinghouse Electric Corporation

continued

# YARWAY news briefs

*from* **Yarnall-Waring Company,** *Philadelphia 18, Pa.*

*BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD*

## HOW YOU CAN SAVE MAINTENANCE...INCREASE OPERATIONAL TIME WITH YARWAY COLOR-PORT GAGES

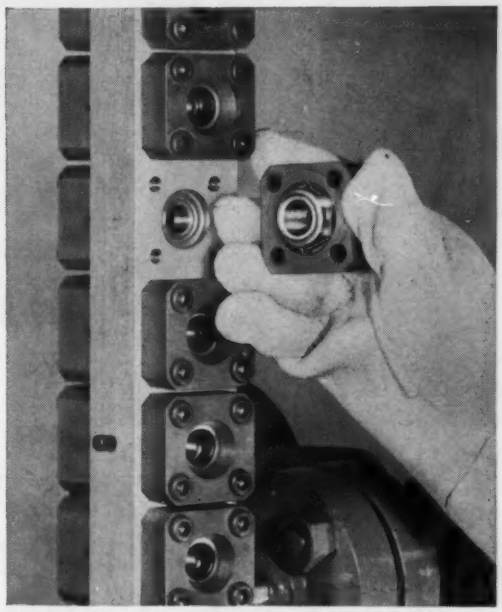
Two big problems confronting the operators of high pressure boilers—excessive maintenance and frequent downtime of water level gages—can be solved with new Yarway Color-Port Gages.

These Color-Port features will help you do the job:

- Patented spring loading of individual port covers, maintains proper pressure on glasses and gaskets at all times.
- Maintenance work can be done *with the gage in place.* NO TORQUE WRENCHES NEEDED!
- Individual "package" port assemblies (glass-mica-gasket) can be replaced in a few minutes.

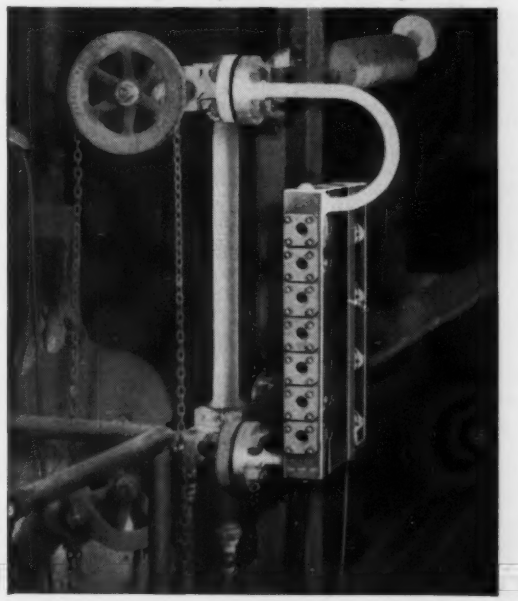
These benefits, PLUS brilliant two-color readings (water space shows green; steam space shows red), PLUS Yarway quality—make COLOR-PORT your best gage buy! 2 Series—1050 psi and 3000 psi.

Write for Yarway Bulletin WG-1815.

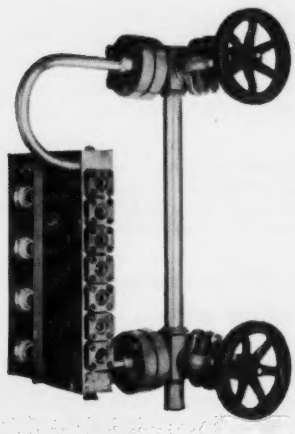


*Servicing the Yarway Color-Port Gage is simple! Just remove 4 cap screws (no need for torque wrench), place new "package" assembly in cover, and replace cover assembly. A matter of two or three minutes.*

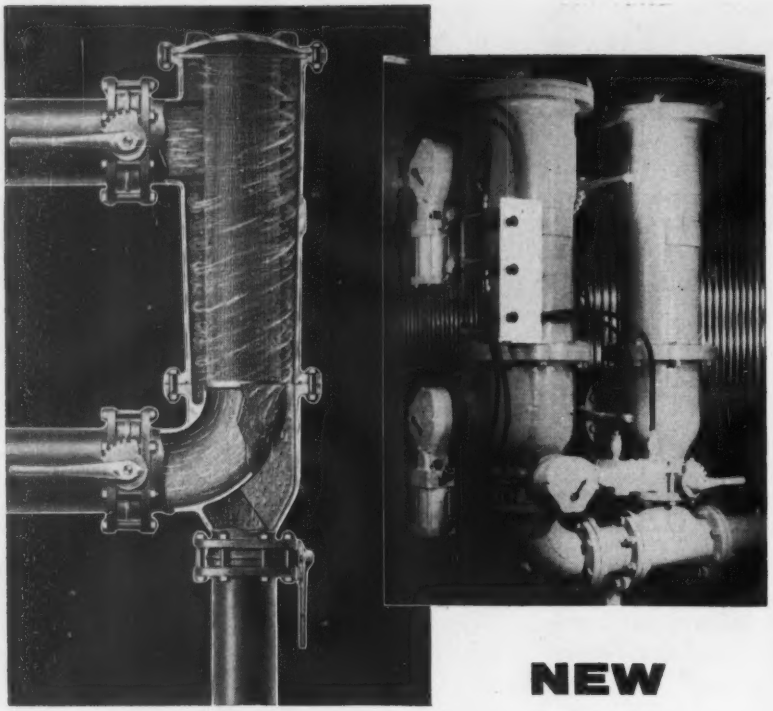
*Yarway Color-Port Gage installed on boiler at Alan Wood Steel Co. Leading industrial plants all over the country as well as many major utilities are among the hundreds of satisfied Color-Port Gage users.*



### NEW COMPACT DESIGN WITH "WELBLOC" VALVES SAVES INSTALLATION SPACE



New "Welbloc" valves on Yarway Color-Port Gages reduce installation space requirements up to 40%. All working parts of valves are easily accessible. Improved direct flow from boiler drum to gage, reduces temperature differential.



NEW

# PRATT Cyclone Strainer ...multiple unit concept solves many strainer problems

**This unique new strainer utilizes a simple, powerful cyclone-like action. Water moves from the outside to the inside of the strainer basket with a vigorous downward swirling action, keeping larger particles from the strainer basket and forcing them toward the trash outlet. The Cyclone stays "on the line" longer, requires less space, less installation cost and less maintenance than any similar unit.**

*COMPACT MULTIPLE UNITS to meet any flow requirements or any reasonable pressure drop. Multiple units are completely adaptable to space limitations and can easily be added for plant expansion.*

*BACKWASHING is simple and can be completed in seconds. Automatic or manual controls are available.*

*EQUIPPED WITH MONOFLANGE MARK II RUBBER SEAT BUTTERFLY VALVES—only one-quarter turn required. These are the only moving parts on a Cyclone Strainer.*

*A detailed bulletin especially useful for Consulting Engineers, contains head loss and flow rate data and typical arrangements. Ask for Bulletin S-1-K*

**Cyclone STRAINER**

**HENRY PRATT COMPANY**
319 WEST VAN BUREN STREET
CHICAGO 7, ILLINOIS

HENRY PRATT

Creative Engineering for Fluid Systems

## Electric application

**180** **This ½-hp motor** features improved performance against fluctuating loads—under full output conditions 0.5 bhp is available. Flywheel stores kinetic energy, resisting transient changes in torque. It reduces loop gain, is supplied for high resistance to torque changes. With flywheel fitted, acceleration is 1000 rpm per sec. With flywheel removed, machine accelerates at 7000 rpm per sec—speed range is to 7500 rpm forward or reverse.—Servomex Controls Ltd

**181** **Electric motor for vibrating** drives has heavy-duty bearings, robust shafts and out-of-balance weights at each end to generate vibration. You can use motor for driving high-speed vibrating screens. It dedusts small coal, debreezes coke, screens foundry sand, chemicals, etc. Totally enclosed, dustproof and weatherproof, unit is nodular cast iron with integral feet. Output ranges from 200 lb at ⅛ hp to 8000 lb at ½ hp.—English Electric Export and Trading Company Ltd

**182** **Sealant acts as liquid shim,** fills slight clearance between bearing OD and worn end-bell housing in electric motors. Plastic hardens to perfect fit, maker claims. You can do the job in less than 15 min.—American Sealants Co

**183** **Hand embossing tool** made of lightweight aluminum is designed for labeling and identifying electrical circuits, pipes, meters, panels and controls. It's quick and economical—you just dial letters and press handle to emboss. Built-in cutoff blade trims finished label to exact size. Embossing dies give sharp raised letters.—Dymo Industries, Inc

Just circle key numbers on the Reader Service card, page 197, to get complete product story

## • Electric-application design aids

**526** **Squirrel-cage induction motors** with basic dripproof design are covered in 12-p booklet. Motors range from 1 to 150 hp. Century Electric Company

Begins on page 264

**527** **Ac motors** from 1 to 2000 hp are self-greasing. Motor selection is covered in 16-p catalog B-2515. Reliance Electric and Engineering Company

**528** **Single-phase,** 3-phase and dc motors are discussed in 16-p application guide 010. Other chapters: gearmotors, selective-speed drives. Century Electric Company

**529** **Motors,** 23 types, are feature of 8-p brochure 2651. Ratings, enclosures and modifications are illustrated. The Louis Allis Company

**530** **Explosionproof synchronous** motors especially for hazardous areas are outlined, ratings and specs charted, in 8-p bulletin. The Superior Electric Company

**531** **Electric-motor book** has 14 pp, gives data for selection and specification. Doerr Electric Corp

**532** **Pumpmotors** brochure contains collection of reprinted technical articles. Lubrication and protection of pumpmotors are covered. U.S. Electrical Motors Inc

**533** **Integral-hp motor** brochure covers manufacturing process. Story is in well-illustrated bulletin PB6000-10. Elliott Company

**534** **Part-winding starting,** d-flange, multispeed and integral-hp vertical motors are topics of bulletins 1465, 1430, 1300 and 1485. Century Electric Company

**535** **Shaded-pole,** fractional - horse - power and permanent-split-capacitor ac motors are subjects of a 4-p folder. Ratings are for 60-c 115-v operation. Leece-Neville Company

**536** **Synchronous motors** are featured in 8-p brochure giving technical characteristics, specs, ratings and outline dimensions of 50-, 150- and 250-oz-in. motors. The Superior Electric Company

**537** **Induction motors,** squirrel-cage type with encapsulated stator, are described with specs tabulated in brochure 6100. The Lincoln Electric Company

**538** **Ac and dc motors,** generators and control equipment are subject of revised 48-p guide to electrical terminology. Fairbanks, Morse & Co, Electrical Div

**539** **Gearmotors** and speed reducers: topics of 6-p bulletin MD-1. Gearmotors range from single to triple reduction, 1- to 150-hp ac. Howell Electric Motors Company

**540** **L-v synchronous-motor controls** are autotransformer or part-winding starting. 16-p booklet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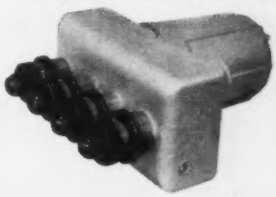
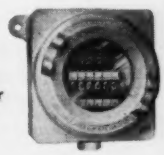


Model EKP-4 provides four separate alarm points.



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3100-PRD-202 details methods using kva reduction. Electric Machinery Mfg Company

**541** **Motor-controls** catalog 60 is pocket size, has 56 pp of descriptions, ratings and prices for manual and magnetic starters, drum controllers and limit switches. Furnas Electric Company

**542** **Drawout motor controller,** 2000- to 5000-v range, is available for squirrel-cage, wound-rotor and synchronous motors—subject of 8-p brochure 14B9739. Allis Chalmers Mfg Company

**543** **Across-the-line motor starters** are illustrated in 36-p brochure 709. Construction, installation and inspection features are detailed. Allen-Bradley Company

**544** **Stator insulations** are feature of open motors illustrated in 12-p bulletin 05-51B9040B published by Allis-Chalmers Mfg Company

**545** **Electric-motor insulation** is featured in 4-p booklet available from Crocker-Wheeler Plant of Elliott Company

**546** **Motor-generator equipment,** 400 cycle, is covered in bulletins. Precision Power Div of American Electronics, Inc

**547** **National Electric Code** requirements for installation and operation of portable electric tools and equipment are listed in revised 8-p booklet. The Arrow-Hart & Hegeman Electric Company

**548** **Mercury-vapor lamps** are covered in 28-p booklet. Manual includes light output, life ratings, necessary auxiliary equipment. Westinghouse Electric Corporation

**549** **Area floodlighting** 16-p guide 2719 is a reference for selecting incandescent or mercury floodlights. Includes ft-c charts and installation diagrams. Crouse-Hinds Company

**550** **Sealed-beam floodlights** accommodate lamps from 75 to 500 w. Ft-c charts and selection info are included in 12-p brochure 2727. Crouse-Hinds Company

**551** **Low-speed synchronous motors** from 20 to 10,000 hp and 72 to 450 rpm are featured in 12-p booklet 502. Chart gives typical torque requirements for applications in all fields. The Ideal Electric and Manufacturing Co

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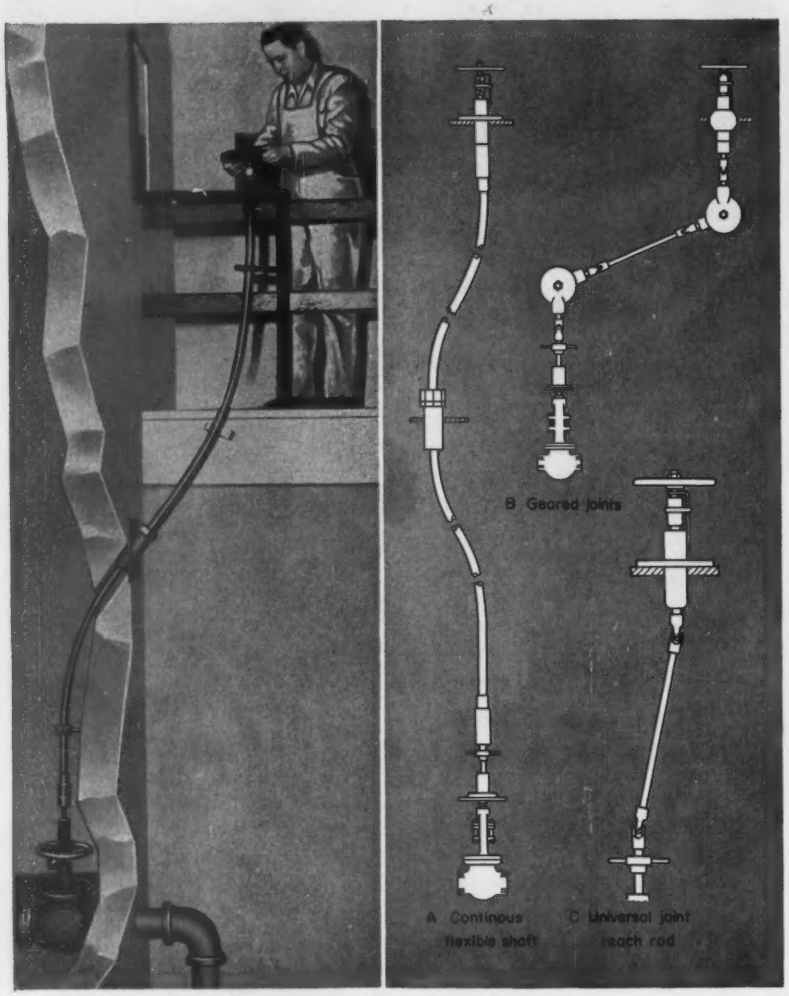


## Typical station arrangements

# Remote control for valves

In recent years increasing numbers of manual remote controls have been installed in industrial power plants and on nuclear reactors. These systems are popular because they eliminate a great deal of hazardous climbing and permit relatively inexpensive control of a number of widely scattered valves.

Stow Manufacturing Co. makes a complete line of these controls, including: flexible shafting, universal joints and geared joints. These controls also include standard remote stations, intermediate connections and valve couplings for both flexible shafting and reach rods.

Typical installations of this equipment are shown above. Sketch "A" shows a flexible shaft that can be used up to 100 ft. in length and is available in sizes up to 1⅜" diameter. Sketch "B" is an installation using geared joints that operate in any angle through 340°.

For complete design data on all sizes of standard flexible shafts, geared joints and terminals, write for Design Manual 5811.

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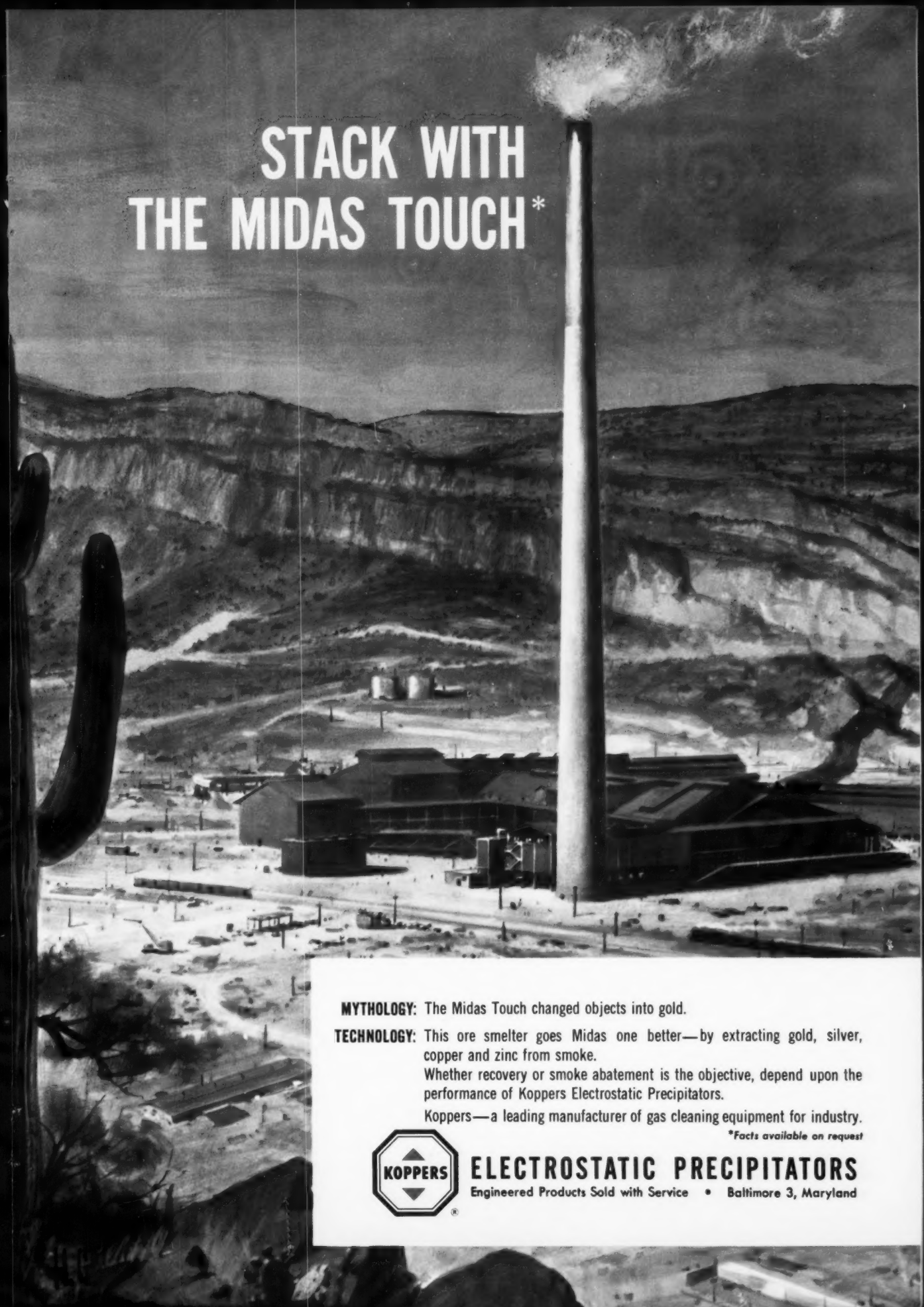


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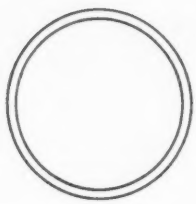
# What's so complex about stainless tubing?



What's so complex about stainless tubing? Proper selection is. There are at least a million combinations of stainless grades, tube types, heat treatments, mechanical properties, physical properties, tube sizes and tube costs to choose from.

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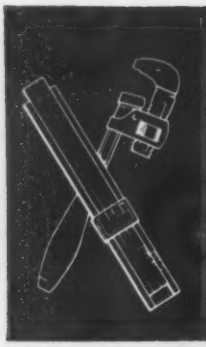

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**Fast warm up through rapid removal of both air and condensate up to 10° F. of saturation.**

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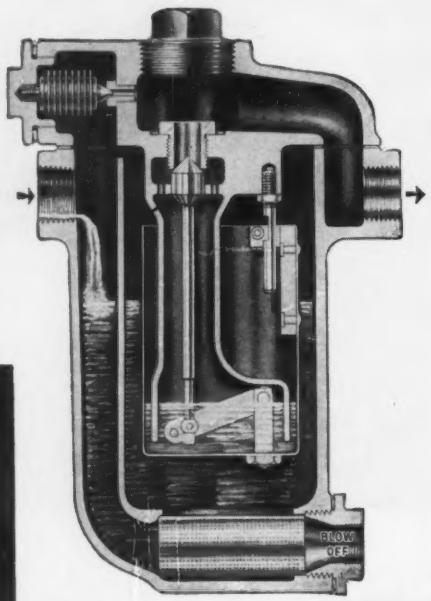
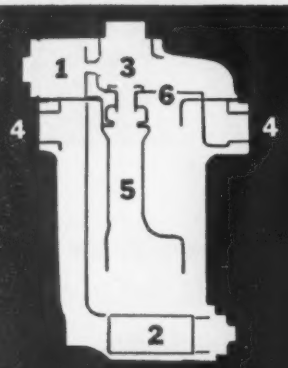
Step by step steam traps have been improved, making them compact, lighter and more efficient, easier and faster to service. Now Wright-Austin has incorporated all these advances into one of their proven vertical bucket-type traps—the new 500-C series. Write for literature.




***500-C Series—For ½" to 2" pipe lines; Pressures to 150 PSIG; Capacity to 30,000 lbs./hr.***

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Accent in mechanical-transmission equipment is on high speed and on speed reduction. This calls for a host of reducers, designed in many ingenious ways. Planetary gearing is used more and more to conserve space, while variable-speed belts and drives solve some tough operating problems. Synthetic materials are mated with metal gears, need no lubrication. All in all, new mechanical-transmission systems are shaping up to the challenge.

Steve Elonka

Associate Editor

## ● Equipment

**184** **5-hp transmission** reverses instantaneously in 0.2 sec even under worst conditions, manufacturer says. Developed primarily for high-speed load positioning, reversing and sequencing in industrial servo and automated systems using card or tape control, transmission can also be used on machine tools to change speed and direction of cutting tools. Unit has built-in amplification and low power requirements.—Airborne Accessories Corp

**185** **Worm-gear speed reducers** feature high capacities—line is available in nine sizes ranging between 3- and 12-in. center distances. Ratios: from about 4:1 to 95:1, ratings: from fractional to 175 hp. Reducer has extremely light, specially constructed radial fan which rotates in either direction, mounts on input side of worm shaft to scour reducer's finned outer wall.—Cleveland Worm & Gear Div, Eaton Mfg Co

**186** **Drive boasts simple design.** Its hydraulic power unit provides variable-output shaft speed from constant-input speed. Yet to come—units for larger hp applications using design of this 5-hp model. Housing can be installed


For more facts circle 939 on Reader Service card, p 197

as a jack shaft or direct coupled to any power train. Basic component's four moving parts are continuously lubricated by oil submersion. Simple design of 30-lb unit is reflected in price, maker states, so it can serve where less power is needed and a conventional mechanical-transmission system would cost too much.—Log-Master Services, Inc

**187** **Shaft-mounted speed reducer** produces 1, 2 and 3 speed reductions for ¼- to 12-hp range. Less than a foot in diameter and 4¾-in. wide, it saves space. All reductions are within the dimensions of the pulley, inside the housing; they range from 2.52:1 to 76:1.—Hart Reduction Pulley Company

**188** **Spur-gear speed-reduction unit** works with small-hp motors. Sturdy and reliable, it's designed for a polyphase motor but you can use it on a 110-v single-phaser. Reducer comes equipped with belt and pulley; overall reduction is 900:1.—Barnes Drill Co

**189** **Standard flexible-shaft assembly** comes in 180 variations. It's offered in four different cable sizes: 0.130, 0:150, 0.187 and 0.250 in. Apply as a standard or panel-mounted flexible shaft with mounting nuts as part of the shaft itself. Shafts come with unidirectional cable for motor-driven or high-speed applications and bidirectional cable for hand control.—F W Stewart Corp

**190** **Wide V-belt pulleys** are rated 1 to 5 hp at 1750 rpm. They provide instantly variable ratios up to 3:1. Each pulley face is independently actuated by its own spring and cam assemblies. Opposite wedging action of each cam and cam follower prevents pulley spread—assuring constant speed at all times, even with overload. Cam action keeps belt in alignment and never under excess tension.—Hi-Lo Mfg Co

**191** **Needle-bearing joints** are available as double-joint-shaft assemblies with or without slip, as short-coupled assemblies or as special assemblies with stub shaft. Joint disassembly is simple and fast, requires no special tools,

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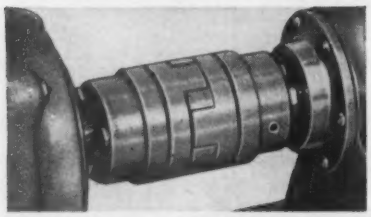
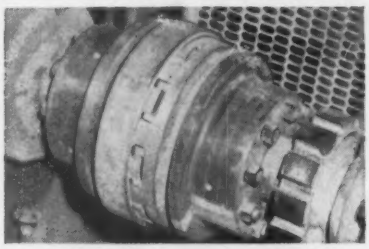
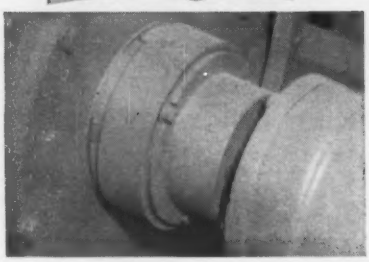
Put 'Em On Shafts



And Leave 'Em Alone



Lovejoy



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## Mechanical transmission

Begins on page 272

maker says. Built by Gelenkwellenbau of Germany, joints are made of case-hardened alloy or heat-treated steel. Double-lip seal fitted to ground journal surface of the cross prevents lubrication leakage and entrance of foreign material. — Twin Disc Clutch Company

**192** **Pan-shaped rubber** flexing element is feature of newly designed cushion couplings. Applications are for high speed, high torque. Designed for speeds up to 5230 rpm, coupling may be used with electric motors or i-c engines to operate compressors, pumps, high-speed fans and blowers.—Dodge Manufacturing Corp

**193** **Variable-speed belts** boast top widths from 7/8 to 3 in., nominal overall lengths from 26.4 to 170 in. Construction is said to withstand intense squeezing action of pulley-sheave walls, provide smooth transmission at full power. Belts are made of fiber-reinforced synthetic rubber—impervious to oil and heat.—Lovejoy Flexible Coupling Co

**194** **Belt splice** is for belts with interwoven carcass. Splice is installed in one piece for a tight, leakproof yet flexible joint. As conveyor operates, hinge plate separates into sections at prescored notches to fit trough curvature. Method of fastening: pointed rivets which separate but don't cut or weaken belt fabric. Available for belts 1/32- to 1-in. thick, up to 72-in. wide.—General Splice Corporation

### • Mechanical transmission system design aids

**552** **Speed drives,** motion and stationary control types, V-belt drives, pulleys, couplings, firm's complete line of mechanical-power-transmission equipment is outlined in well-illustrated catalog 23103. T B Wood's Sons Co

**553** **Variable-speed drives** with multiple - groove variable - pitch sheaves are topic of 22-p catalog MVP-101-A. Drive tables are given. Browning Mfg Co

**554** **Adjustable-speed drives** for application in 3/4- to 2500-hp drive


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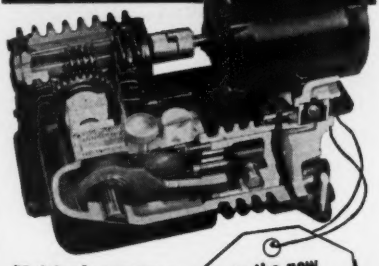

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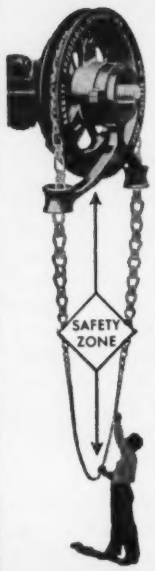


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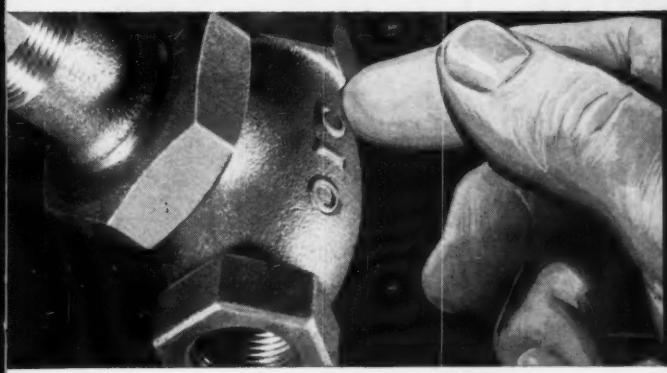

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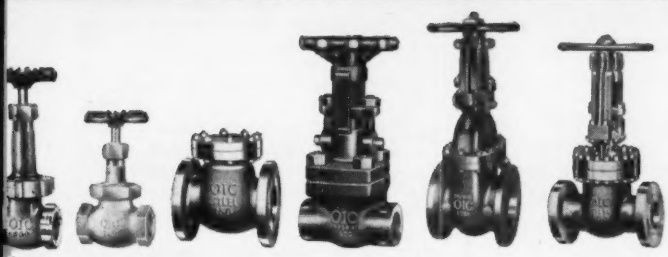

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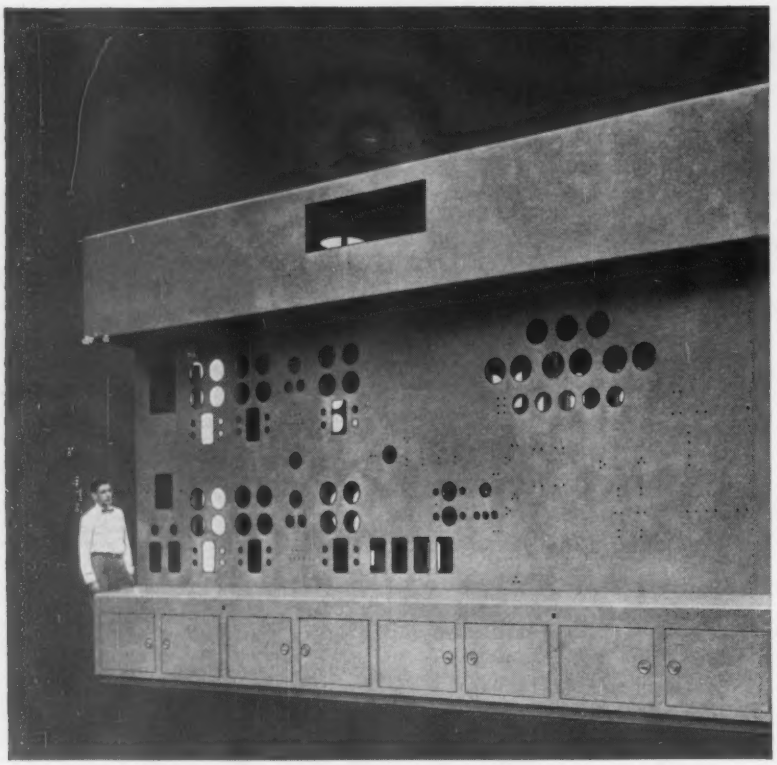

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## Mechanical transmission

range are shown in 6-p booklet 2900. Speed ranges, ratings and associated controls are given. The Louis Allis Company

**555** **Shaft- and flange-mounted drives** with torque range up to 44,000 in.-lb are explained in revised 36-p catalog 7100. Included: discussion of predrilled steel motor mounts. The Falk Corporation

**556** **Speed reducers,** parallel-shaft type, are featured in 36-p book 2719. Balanced-design equipment in 57 sizes, capacities to 2800 hp is covered. Link-Belt Company

**557** **Planetary - gear transmission,** shaft-mounted differential unit with capacity through 60 hp, is featured in 8-p bulletin LR-60. Airborne Accessories Corp

**558** **Friction clutch** controls torque, dissipates heat through cast-iron hub-and-pressure plate to combat distortion. Details are in bulletin available from Vickery Div of Norwalk Tool and Die Inc

**559** **Modern gears,** advanced concepts are featured in publication describing production methods, facilities. Philadelphia Gear Corp

**560** **Packaged bearings** run on hydrodynamic oil film — described in brochure. Tann Bearing Co

**561** **Timing-drive-selection** bulletin gives 5-step method to select drive. Bulletin 21103 has 8 pp. T B Wood's Sons Co

**562** **Drive catalog** has 24 pp, gives engineering data to aid selection and installation. Hp ratings, installation instructions are tabulated. Maurey Mfg Corp

**563** **Takeups** with sleeve, ball or roller bearings in seven frame sizes are topic of 16-p brochure 2741. Link-Belt Company

**564** **Sleeve bearings,** self-aligning and self-lubricating, come in flanged and pillow-block types for service up to 1000 F, underwater or in corrosive conditions. 6-p folder 2823 is from Link-Belt Company

**565** **Oil-less bearings** operate from -270 to +375 F. 12-p catalog 511 lists cylindrical and flange bearings. Arguto Oilless Bearing Company

**566** **Wide inner ball bearings** and power-transmission units are topics of 60-p booklet. They mount easily on straight shafts without shoulders or adapters. The Fafnir Bearing Company

**567** **V-band coupling** applications are discussed in 8-p booklet WB-1. Available coupling and flange

Begins on page 272

configurations are pictured. Marman Div, Aeroquip Corporation

**568** **Power-drive flexible couplings** are charted in 4-p folder J-23. Describes double- and single-engagement, extended and mill-motor couplings. Hewitt-Robins, Inc, Jones Machinery Div

**569** **Flexible cushion couplings** for high-speed high-torque applications or for attaching to i-c-engine flywheels are described in 20-p bulletin from Dodge Manufacturing Corp

**570** **Couplings,** grid-groove design, protect machines from shock and vibration. Revised bulletin 4100 presents charts and tables in its 32 pp, includes one chapter on selection. The Falk Corporation

**571** **Pulleys,** speed-pulley drives and belts, sheaves, motor and countershaft bases are depicted in 34-p catalog 61B. Lovejoy Flexible Coupling Company

**572** **Belting** catalog has 36 pp, gives specs, info on firm's line of conveyor, elevator and transmission belting. Cross sections show belt construction. Boston Woven Hose & Rubber Div of American Biltrite Rubber Co

**573** **Endless-woven flat belts** are detailed in bulletin available from Arthur S Brown Mfg Co

**574** **Nylon-polymer-core belting** is featured in 12-p catalog. Graphs help determine proper belt type; width and tension are charted. Extremultus, Inc

**575** **Chain drives** are cataloged in 92 pp. Selection procedures and application data are given with tables, charts and formulas to locate dimensions, capacities, hp ratings and specifications. The Whitney Chain Company

**576** **V-belts,** malleable-iron bushing system, roller chain and sprockets are some topics in 24-p catalog GC-101-F from Browning Mfg Co

**577** **V-belt clutch selection** is covered in 16-p booklet 40. Describes general-purpose, heavy-duty and ball-bearing clutches. V-Belt Clutch Company

**578** **Timing-belt drives** for load capacities to 600 hp and belt speeds to 16,000 fpm are subject of 80-p catalog 19103. Charts provide graphic selection of proper pitch, drive width and belt-pitch length. T B Wood's Sons Co

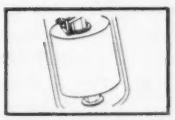
**579** **Mounted bearings** are described in 82-p brochure 10A. Radial load ratings are given for ball, interlock, steel and special bearings. Pillow blocks and takeups are also illustrated. Dodge Manufacturing Corp


in any steam trap...

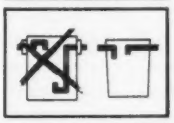
# IT'S WHAT'S INSIDE THAT COUNTS

*Inside*

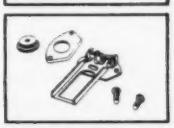
## *SUPER-SILVERTOPS*



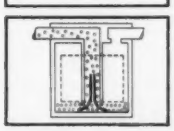
GUIDED BUCKET—Inverted bucket is guided on patented center tube. Results in perfect alignment—no damage to internal parts. Guarantees positive leakproof seating of valve.



NO RESTRICTED PASSAGES—Passages are short, liberal size, clean and smooth bore. Cannot clog with foreign matter. Assure full operating efficiency for trap life.



ANDERLOY VALVE AND SEAT—Eliminates erosive effect of steam. Held in place with clamp and stainless steel screws. Easily removed.



REVERSE FLOW—Bucket remains stationary and the valve open, even during heavy load periods. Stirs up sediment—keeps trap clean.

QUALITY ENGINEERING—The above features of Super-Silvertop Steam Traps are indicative of the outstanding engineering principles employed in the manufacture of all Anderson Steam Specialty products.

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BY THE MANUFACTURERS OF Hi-eF PURIFIERS

*THE V. D. ANDERSON COMPANY*

*Division of International Basic Economy Corporation*

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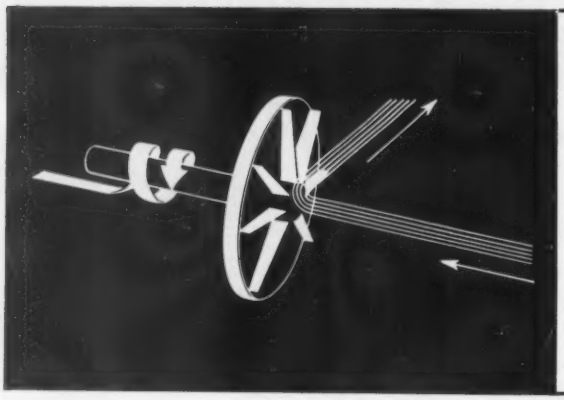
# FLUID-HANDLING SYSTEMS



Two features characterize new pumping equipment: improved canned-motor-pump designs are strengthening their hold in fields where absence of stuffing boxes pays off; better bearing construction increases unit reliability. Parts standardization within a line cuts spare-parts inventory needed for on-stream systems.

Size and variety of packaged water-treating equipment is on the increase (see pp 82-83). Growing acceptance of automatic water analyzers makes it possible to fully automate more complete water-treatment systems.

R H Franke
Associate Editor

## Water-treatment equipment

**195** **Chlorinator** for industrial water and waste-treatment facilities features a safety stack regulator which houses all control components. Design is simple—there are no frail piping or connections, potential leak sources. When unit isn't operating, shutoff valve seals chlorine supply; isolating valve seals moving parts—not even traces of water can enter chlorinator from ejector backpressure.—Fischer & Porter Company

**196** **Electrodialysis water-conversion** process recirculates the concentrate, converts brackish water to fresh. Water is fed between two ion-permeable membranes and an electric current flows through the cell. Membranes are thin for greater flexibility. One passes positively charged ions, the other negatively charged ions; ions move through the membranes and concentrate in alternate cells. Liquid in intermediate cells is freed of from 2 to 40% dissolved solids. Dissolved-solid concentrate is drawn off and fed back to alternate cells, reducing the current resistance. According to maker, this also cuts amount of acid needed to acidify the concentrate.—Aqua-Chem, Inc

**197** **Cooling-water treatment** products meet needs of medium- and small-sized air-conditioning installations. Four products are available in briquette form—a combination of polyphosphates, selected organics and inhibited dry acid for control of scale, corrosion and alkalinity. Feed is accurate and continuous with visual control using the company's stoker-feeders. Dry-acid content eliminates hazards of liquid-acid handling.—Dearborn Chemical Company

**198** **General-purpose feeder** handles chemicals in powder, granule or lump form up to 3¼-in. dia. Maker suggests applications in water- and waste-treatment industries. Unit has finely balanced weighing mechanism giving accuracy of ± 1% of the set rate over an operating range of 20:1.—Infilco, Inc

## Compressors

**199** **Medium-speed compressors,** balanced-opposed 2- and 4-cylinder units, are engineered for direct drive with the company's natural-gas engines. Design provides continuous, unattended heavy-duty service gathering gas, lifting, repressuring and boosting. Matched engine-compressor sets operate at 600 to 900 rpm. Compressor uses a 6-in. stroke; the 2-cylinder compressor is rated from 200 to 635 bhp, 4-cylinder model up to 1000 bhp. Standard cylinders in 68 sizes mount interchangeably. They range from 2⅝-in. dia, 4000 psi to 22½-in. dia, 85 psi.—White Diesel Engine Div, White Motor Company

**200** **Air-cooled 2-stage** 100-lb air compressors are compact and efficient. Extra weight, water-jacketing expense, cooling-water needs are ended. Built in 25-, 50-, 75- and 100-bhp sizes, units come as basic compressor, base-mounted without motor or base-mounted package with electric-motor drive.— Clark Bros Company

**201** **Stationary rotary compressors** in 2- to 125-hp sizes have new type oil separator which reduces amount of oil the compressor consumes and oil content in air the compressor produces. Separator has an inorganic fiberglass element. This accumulates fine particles of oil that drain back to intake section of compressor through pressure-reducing oil-return valve. — Davey Compressor Company

**202** **400-hp stationary air compressor** delivers 2280 cfm of air, works up to 125 psi. Machine is designed for heavy-duty 3-shift operation in industry, or on construction jobs and in mines. It comes packaged, needs only bolting to a steel frame preset in the concrete foundation. The 2-stage double-acting machine has cylinders arranged in an el. Good design and balance reduce specific power consumption; short stroke gives a high capacity-to-weight ratio.—Atlas Copco

**203** **V type gas-engine compressor** is rated 5500 bhp. Turbocharged, 2-cycle machine for pipeline gas transmission combines high hp, low fuel consumption, simplicity and dependability, says maker. Compressor cylinders located on one or both sides of crankcase make maximum use of space and give cylinder flexibility for wide range of applications. Unit can be fitted with as many as eight large cylinders to handle all types of pipeline and process requirements—including multiservices where several gas streams are compressed by one machine.—Clark Bros Company

**204** **100-hp stationary heavy-duty compressor** is designed for 'round-the-clock operation. It delivers from 509 to

565 cu ft of air per min at pressures up to 125 psi, features low first cost, running economy, long life. The DT4 is a short-stroke 2-stage double-acting fully air-cooled unit. It's intended for stationary operation, but can be mounted on bonded rubber, made semi-portable—useful where normal concrete foundations aren't practical.—Atlas Copco

**205** **Compressor designed for 1500 to 3000 bhp,** Model TBA, has 17x17-in. bore and stroke. These gas-engine compressors come in 5-, 6-, 8- and 10-power-cylinder models. Components are designed with inherent stamina required for high turbocharging power, maker claims. —Clark Bros Company

**206** **Reciprocating air compressors** range from 7½ to 150 hp. Direct-connected and V-belt-driven machines are available. Single-stage compressor is for operation at 50-psi, 2-stage at 125-psi continuous pressure. Individual cylinders of nickel-iron alloy feature deep radial fins for best cooling and low operating temperatures. —Davey Compressor Company

**207** **Atomizing steam ejector** performs in ranges of 10 to 50 F above saturation temperature with adequate pressure and temperature controls. Atomizing steam pressure must be at least 1½ times superheater steam pressure and 2% of total flow. Feature: straight-through-flow design for installing directly in the superheated steam line with welded, flange or nozzle connections.—Schutte and Koerting Company

## ● Pumps

**208** **Centrifugal pumps,** totally enclosed and hermetically sealed, handle toxic, inflammable or highly volatile liquids. The self-adjusting bearings automatically compensate for radial and axial wear, are designed for long life—minimum clearance between bearing and journal cuts down grit and dirt damage. 13 sizes have discharges from 1 to 5 in., serve up to 120 psig and 40 to 250 F. In event of excess loads, automatic thermoprotectors imbedded in stator windings prevent motor burnout. Rotor bearings operate in and are lubricated by the fluid being pumped.—Buffalo Pumps Div, Buffalo Forge Company

**209** **Diesel-powered centrifugal pumps** are cooled by air. Self-priming units come in 2-, 3-, 4- and 6-in. openings. Capacities range from 15,000 to 90,000 gph. Diesel engines are offered in 4-cycle air-cooled crank-start types; electric starters are optional. Pumps mount on high-speed trailers with pneumatic tires, skids or conventional wheels.—Rice Pump & Machine Company

**210** **Packaged close-coupled end-suction centrifugal pump** is compact, requires less space. Unit can be disassembled completely without disturbing the suction or discharge piping. It vents itself, eliminating possibility of vapor lock and providing smooth, quiet operation. Capacities range up to 400 gpm, with heads to 150 ft. —Aurora Pump Div, New York Air Brake Company

**211** **NEMA-matched centrifugal-pump** dimensions align with those of NEMA-rated motors for easy mounting and installation, says maker. Designed to furnish a wide range of clear water, pump frames will receive various size volutes and impellers. You can install without makeshift height-adjusting blocks and odd-bore couplings.—Fairbanks, Morse & Company

**212** **End-suction centrifugal pump** adapts to different applications and handles capacities to 3000 gpm. Power frames take a variety of liquid ends and motors, increasing capacity to meet pumping requirements. Liquid ends may be cast iron, all bronze, stainless steel or alloys. In case of normal impeller wear, design allows on-line adjustment.—The Deming Co

**213** **Standardized chemical pump** offers maximum interchangeability of parts and pumping units. First cost and costs of engineering, installation and maintenance are cut, according to manufacturer; smaller inventory saves space and money. Available in ductile iron at no price penalty, model 3195 is a horizontal end-suction single-stage centrifugal. Capacities range from 5 to 775 gpm, working pressures from 0 psia to 275 psig. —Goulds Pumps, Inc

**214** **Turbine pump** is designed for booster service up to 60 psig in suction on boiler-feed, condensate-return, transfer or circulation lines. Maintenance-free mechanical seals can be chosen where weekly maintenance of packing isn't possible. Pump comes in 85 sizes. Maximum limits: 160-psig discharge, 60-psig suction, 110-psig for the mechanical seal and 210-F temperature. Liners are renewable for easy field repair.—Roy E Roth Company

**215** **Series-300 proportioning pump** lets you adjust capacity while pump is running. Control mechanism combines output of the two cams to vary stroke, zero to maximum. Simplex model features capacities from 1 to 812 gph, duplex from 2 to 1624 gph.—American Meter Company

**216** **Metering pump** now adjusts at forward end of stroke. Low-flow controlled-volume pump serves in liquid-chemical-feed systems. Pump's speed reducer and drive unit convert high-speed rotary motion into low-speed reciprocating motion with a minimum of working parts and bearing surfaces. Connecting-rod bearings are continuously lubricated; all enclosed working parts operate in an oil bath. Drive unit provides 0-to-100% stroke adjustment without lost motion—this makes resulting capacity change approximately linear. Liquid end is continuously scavenged to minimize compressibility effect. Capacities range from 0.89 gph for pressures up to 4470 psi to 88.0 gph for 170 psi.—Milton Roy Company

**217** **Leakproof canned pumps** feature thrust-balance design combined with larger bearings, tripled radial bearing surfaces. Result, according to maker: extra-long bearing life. An oil-filled stator cavity dissipates heat from motor windings so motor lasts longer.—Fostoria Corporation, Chempump Div

**218** **Internal-gear rotary pump** handles viscosities from thin to 80,000 ssu. Pump uses only two moving parts —design results in greater pumping capacity in less space. Sizes range from ⅜ to 8 in. for pressures to 200 psi and capacities from 1.5 to 1050 gpm.—The Deming Company

continued

**219** **Submersible 8-in. pump** boasts high capacities, aims to meet demands of industrial, commercial and municipal water supply. Series F comes in 10- through 50-hp sizes with capacities from 150 to 550 gpm. One feature: bronze bowls and impellers to boost corrosion and wear resistance.—Sumo Pumps, Inc

**220** **Slurry pump** nears clear-water efficiency, copes with both abrasive and corrosive slurries. Design shoots for low costs, easy maintenance, reliability. Standardized-component line has 11 models from 1 to 4 in. — Morris Machine Works

## ● Controls and analyzers

**221** **Multiunit automatic control panel** takes on as many as five electric-motor-driven compressors. Panel lets you control all compressors at once or any one in the group manually or fully automatically. In automatic operation, no two machines can start at the same time; each preceding unit must be running before next can start. Automatic shutdown devices can be tied into system to protect equipment. — Clark Bros Company

**222** **Analyzer detects silica contents** in boiler feedwater down to 0.2 ppm. Every 12 minutes, unit automatically takes measured water samples. Twin photocells compare sample with reference filter. Cells' differential output feeds amplifier which drives pen recorder.—Electronic Instruments Ltd

**223** **Continuous analyzer-recorder** prevents dangerous silica concentrations in effluent water of demineralizer systems. Automatic chemical analysis continuously records silica concentration down to one part per billion. Complete automation of dimineralizer plants is possible with on-stream system, says maker. Analyzer also can automatically signal an alarm, switch the system from one resin bed to another and activate automatic regeneration of the depleted bed.—Technicon Controls, Inc

**224** **Photometric absorption** analyzers give simple reliable absorption analysis in the 2100-A ultraviolet to 3-microns-infrared region. Use them to monitor or control absorbing components in gas or liquid process streams.—Analytic Systems Company

## Fluid-systems design aids: Reader Service card, p 197, orders your copies

### ● Water treatment

**580** **Techniques** used in followup geophysical-investigation programs for underground-storage facilities are described in 8-p brochure. Mineral Fuels Div, Geotechnics and Resources, Inc

**581** **Demineralizers,** mixed, two and four bed, are presented in 36-p catalog 160. Firm's complete line is covered. Barnstead Still & Sterilizer Company

**582** **Liquid-blending** systems are topic of 8-p bulletin 650. Equipment is designed for 1 to 2000 gpm. Blackmer Pump Company

**583** **Submerged leakproof filter** systems, chambers featuring visibility during operation and stainless-steel filter chambers are subjects of bulletins 551A, 401 and 402. Sethco Mfg Corp

**584** **Sludge collectors** for rectangular settling tanks are detailed in illustrated 28-p booklet 2746. Includes data on selecting tank size and ten states' standards for tank design. Link-Belt Company

**585** **Disposable-cartridge** demineralizers up to 1500 gph are shown in 6-p folder 154. Applications include electronic, nuclear and pilot-plant operations. Barnstead Still and Sterilizer Company

**586** **Selection** of water - treatment equipment for high-makeup boilers in 600- to 1250-lb range is covered in 10-p article T-183. Case histories of two plants and treatment and testing methods are discussed. Graver Water Conditioning Company

**587** **Tray deaerators** for corrosion protection in boiler - feedwater systems are topic of 4-p bulletin. The Permutit Company

**588** **Varieties of process-water** treatment are explained in catalog 360. Boiler feed, chemical and wastes are covered. Commercial Chemical Products, Inc

**589** **"Cooling- and circulating-water** problems" is title of 4-p article. Chapters deal with troubles in hot- and chilled-water systems, diesel and gas engines, compressors, cooling towers. Associated Laboratories, Inc

**590** **Treatment** of boiler- and cooling-water systems: subject of 4-p maintenance and troubleshooting checklist CS 113. Lists diagnosis of scaling, corrosion and foaming. Ionac Chemical Company

**591** **Maintaining an alkaline pH** in steam and condensate-scavenging systems is explained in bulletin. Ionac Chemical Company

**592** **Storage hot-water tanks** to 6570 gal, heating elements to 33,000 gpm are topic of 8-p catalog BH-2N. The Sims Company

**593** **Vertical and horizontal** tank heaters boast 1-weld single-pipe construction. 8-p brochure 1623 is available from The Griscom-Russell Company

**594** **Storage water heaters** are described in 8-p publication 1234. One section gives info on indirect gas-fired heater with 250- to 4000-gal storage capacity. The Patterson-Kelley Co, Inc

**595** **Coagulation chemistry** as applied to water treatment is discussed in 8-p illustrated brochure A-1. One topic: in-line clarification. Nalco Chemical Company

**596** **Demineralizer** data is covered in 30-p catalog WC-111A: principles of demineralization, design, regenerating systems, accessories. Complete with flow diagrams, operating costs, performance curves and chemical-conversion tables. Graver Water Conditioning Company

**597** **Water and waste treatment** equipment buyers' guide 1010 covers aerators, degasifiers, deaerators, precipitators and ion exchangers. Lists size ranges and tables in 16 pp. The Permutit Co

**598** **Water treatment**—municipal and industrial — sewage and waste-treatment products and processes are covered in 30-p bulletin 80-A from Infilco Inc

### ● Compressors

**599** **Rotary-compressor** 24-p bulletin ACO 100.4 features performance—capacity to 21,000 cfm and pressure to 250 psig. Design, construction and application are chapters. Fairbanks, Morse & Company, Compressor Div

**600** **Packaged compressors** in 825- to 1000-bhp range are 2-cycle turbocharged integral gas-engine-driven units. 6-p brochure 191 gives details. Clark Bros Co

**601** **Packaged high-pressure** compressor systems for military, commercial, lab and pilot-plant use are illustrated and described in 8-p bulletin 189. Clark Bros Co

**602** **Design considerations,** mechanical and hydraulic, for 2-stage centrifugal pipeline compressors are detailed in 10-p bulletin 187. Clark Bros Co

**603** **Single-stage-compressor** bulletin P-13 features 6-step selection method for choosing the proper compressors. Elliott Company

**604** **Vertical compressors,** packaged type for 125 psi in 50- to 2000-hp sizes, are topic of 8-p catalog V-100. Bury Compressor Company

**605** **Questions and answers** about valves and their operation in reciprocating compressors is the topic of 44-p booklet. Ingersoll-Rand Company

**606** **Compressors** have ratings ranging from a low of 200 hp to 10,000-hp maximum. Working pressures: vacuum to 15,000 psi. Operating characteristics and specs are given in 4-p bulletins 96, 97, 98 and 99. Cooper-Bessemer Corp

**607** **Jet compressors,** fixed nozzle, manually or automatically controlled spindle, are described in 16-p catalog 4F. Schutte and Koerting Company

**608** **Packaged air compressors,** 25 to 100 hp, are described in 6-p pamphlet 203. Clark Bros Co

**609** **Reciprocating compressors,** single and 2 stage from 7½ to 150 hp, are cataloged in bulletin from Davey Compressor Co

## • Pumps

**610** **End-suction centrifugal pump** has 5- to 775-gpm capacity, –350 to +500-F temperature range. Bearing-life info, pressure-temperature chart and frame-selection table are chapters of 16-p bulletin 725.1. Goulds Pumps, Inc

**611** **Pneumatic pumps** for problem materials are introduced in 4-p book 4601. Yeomans Brothers Co

**612** **Cost of electric pumping,** methods for testing pump, deep-well surveying are explained in 20-p manual EM-77. Peerless Pump, Hydrodynamics Div

**613** **Centrifugal pumps** with canned stator and flow-through rotor impeller are detailed in 4-p catalog M-60. The Corley Co, Inc

**614** **Multistage centrifugal pumps,** opposed-impeller type for hot or cold water, hydrocarbons, chemicals, acids, condensates, handles medium - pressure boiler - feed service, hydraulic driving. Story is in 4-p bulletin available from Pacific Pumps, Inc

**615** **Vacuum-diffusion-pump** catalog gives basic descriptive info on diffusion and booster pumps, shows speed curves for small, medium and large models ranging from 1 to 32 in. NRC Equipment Corp

**616** **Packaged centrifugal pump** with 400-gpm capacity is a close-coupled end-suction type. Performance is charted in 4-p folder 117 from Aurora Pump Div, The New York Air Brake Company

**617** **Sealless, leakproof** pumps are features of spec sheets 1030-3 and 1052-1. Chempump Div, Fostoria Corp

**618** **Multistage centrifugal pumps** with 2600-gpm capacity and 1200-psi working pressure are covered in 8-p booklet 722.4. Goulds Pumps, Inc

**619** **Vertical-duplex** and horizontal-triplex pumps handle from 100 to 10,000 psi, 500 F. Data is available from John Bean Div, Food Machinery & Chemical Corp

**620** **Regenerative-turbine-pump** selection, performance and mechanical data are given in catalog 101. The Roy E Roth Company, Turbine Pump Div

**621** **Double-suction** centrifugal pumps providing capacities from 100 to 6400 gpm are shown in 16-p catalog 721.6. Pumps are available with choice of grease- or oil-lubricated bearings and in stainless steel or ductile iron. Goulds Pumps, Inc

**622** **High-capacity** 3550- and 1750-rpm submersible pumps for industrial water-supply systems are subject of 8-p brochure B1400. Sumo Pumps, Inc

**623** **Impervious-graphite** centrifugal pumps with capacities to 140 gpm and heads to 67 ft are topic of illustrated 4-p bulletin S-7253. National Carbon Company

**624** **Single-stage centrifugal** pumps with capacities to 775 gpm and heads to 300 ft are detailed in 16-p bulletin 725.8. Bulletin gives bearing-life and shaft-deflection data and frame-selection chart. Goulds Pumps, Inc

**625** **Vertical close-coupled pumps,** topic of 4-p folder, are compact—available in wide capacity and material ranges. Sempco Corp

**626** **Controlled-volume** motor-driven pumps are subject of a well-illustrated 32-p catalog 553-2. Selection data guide and capacity-pressure tables are features. Milton Roy Company

**627** **Power-driven** variable-capacity hand- and truck-mounted, and liquefied-gas pumps are pictured and described in 8-p bulletin from Blackmer Pump Company

**628** **Split-case pumps,** 2-stage vertical type, are featured in bulletin. Capacities range to 1400 gpm, heads to 425 ft. Aurora Pump Div of The New York Air Brake Co

**629** **Leakproof chemical pumps** with automatic thrust balance and oil-filled stator cavity are detailed in 4-p folder 2050. Cross-section and performance curves of canned pumps are included. Chempump Div, Fostoria Corp

**630** **Plunger pumps** for metering against pressures to 1200 psi are detailed in 8-p booklet 420.100. Pump features unitized construction with enclosed drive. Wallace & Tiernan Inc

**631** **Single-stage centrifugal** pumps for service from –350 F to +1000 F are described in 12-p circular 184. Materials specifications are given. Dean Brothers Pumps Inc

**632** **End-mounted centrifugal** turbine pumps are topic of 36-p booklet. Motor selection, gravity and viscosity conversion are chapters; features 84 performance curves and calculations. The Roy E Roth Company, Turbine Pump Div

**633** **Sump-pump motors,** rated 1/3 hp, 1725 rpm, are subject of 6-p bulletin GEA-6687A available from General Electric Company

**634** **Pump motors** and drives are subject of 20-p brochure F-2002. Units are indexed according to construction, enclosure and thrust —then you turn to chosen motor or drive's rating, description and dimensions. U. S. Electrical Motors Inc

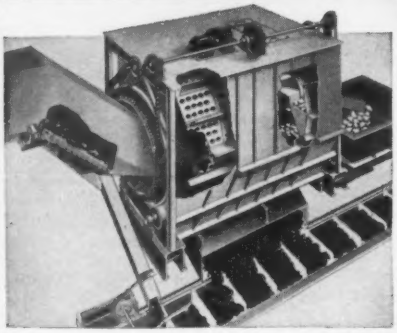
**635** **Ball bearings** for centrifugal pumps are topic of bulletin 6. Discusses axial- and radial-thrust problems. Peerless Pump, Hydrodynamics Div, Food Machinery and Chemical Corporation

**636** **Cost of stuffing-box leakage** and ways to overcome this are subject of 4-p circular. Daily and yearly leakage costs based on value of liquid metered are charted. Lapp Insulator Company, Process Equipment Div

**637** **Adjustable - speed** drives for pumping are discussed in 8-p brochure 5560. Drive - selector

# RUGGEDLY BUILT

## —to cut your coal processing costs

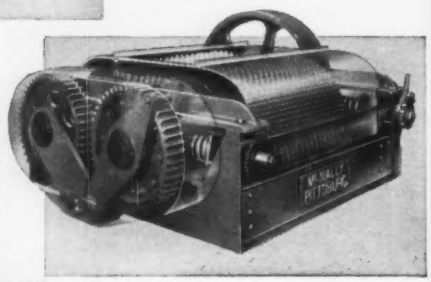


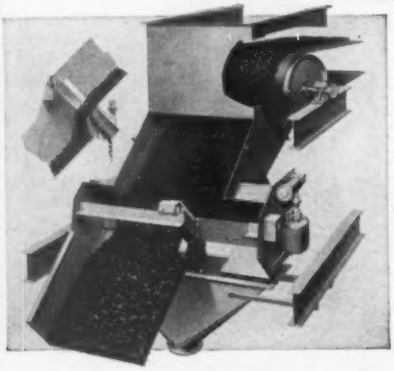
**Rotary Breaker**

This heavy-duty unit allows positive control of top size in handling run-of-mine breaking for final plant use. Production of fines is held to a minimum. Without center shaft or spoke interference, costly maintenance is drastically reduced.

**Gearmatic Stoker Coal Crusher**

Built to handle heavy tonnages, these crushers have proved most efficient reducing 8″ minus to stoker grades. They offer high production, accurate sizing, and low percentage of fines.





**Primary Coal Sampler**

This automatic sampler (adjustable from 1 to 30 minutes) cuts out true samples of the coal stream. Cutter opening permits largest particle of stream to pass freely into cutter. Conveyor discharges to chute in which sampler is installed.

*Ask the men who know coal from the ground up!*

Your McNally Pittsburg man offers more than 37 years of experience in the preparation of coal. He can save *you* time and money in the selection of equipment to do your job more efficiently. *Write today!*

**McNALLY PITTSBURG**

MANUFACTURERS OF EQUIPMENT TO MAKE COAL A BETTER FUEL

McNally Pittsburg Mfg. Corp.
Dept. PO, Pittsburg, Kansas
Gentlemen: Send me more information on these products:
☐ Rotary Breaker ☐ Coal Crusher ☐ Primary Coal Sampler

Name_____ Title_____

Company_____

Address_____

City_____ State_____


## Fluid-handling systems

Begins on page 278

guide covers municipal water-treatment stations, constant-pressure and pipeline pumping. Westinghouse Electric Corp

## • Controls and analyzers

**638** **Governor** for gas-air applications is featured in 4-p bulletin 114. Operating and design features are given. American Meter Co

**639** **Flow-responsive equipment** combines fluid meters and proportioning pumps for continuous process. Units are controlled from one source — 4-p booklet 1400-20-1 comes from B-I-F Industries

**640** **Meter** measures steam, air or gas in 1-in. lines and larger. 4-p folder 400.20-1 features pressure-compensating counter which corrects readings for line-pressure variations. B-I-F Industries, Inc

**641** **Control** and regulation equipment for steam, water, air, oil and gas is covered in 4-p booklet available from McAlear Mfg Company

**642** **Flow-metering** differential producers — venturi tubes, nozzles and flume liner—illustrated in 8-p catalog. B-I-F Industries

**643** **Portable pH meters** measure over the full 0- to 14-pH range — they're topic of bulletin 720-C. Beckman Instruments, Inc

**644** **Automatic analysis** of aldehydes and total acidity: topics of two sheets. Technicon Controls, Inc

**645** **Electrolytic-conductivity meters** are diagramed in 4-p folder E-95(3). Shows unit operation, hook-up to a typical control system. Leeds & Northrup Company

**646** **Spectrophotometers** can adapt to flame photometry, fluorometry, reflectometry. Details in 14-p book 738. Beckman Instruments, Inc

**647** **Water, resin tests** are included in ion-exchange resin-comparator chart and price list available from General Ionics Corp

**648** **Gas chromatograph** can be equipped for fast trace analyses —subject of 16-p booklet. Beckman Instruments, Inc

**649** **Gas-survey recorder** cuts load-research costs. Details in 4-p catalog 35-1543. Fischer & Porter Co

**650** **Automatic analysis** of boiler-water ammonia content down to ppb is topic of 4-p data sheet—from Technicon Controls, Inc

**651** **Electrolytic conductivity** 28-p catalog 23 contains addendum sheets bringing it up to date. Items of interest: indicator controller, dissolved oxygen analyzer, selector switches and recorders. Industrial Instruments Inc

# How Empire State Building and American Airlines solved vital fire protection problems with EVERLASTING VALVES

102 stories, 1,472 feet high, 16,000 tenants and 35,000 visitors sum up the fire protection problem of the Empire State Building. An in-building fire protection system is necessary to an unfailing water supply.

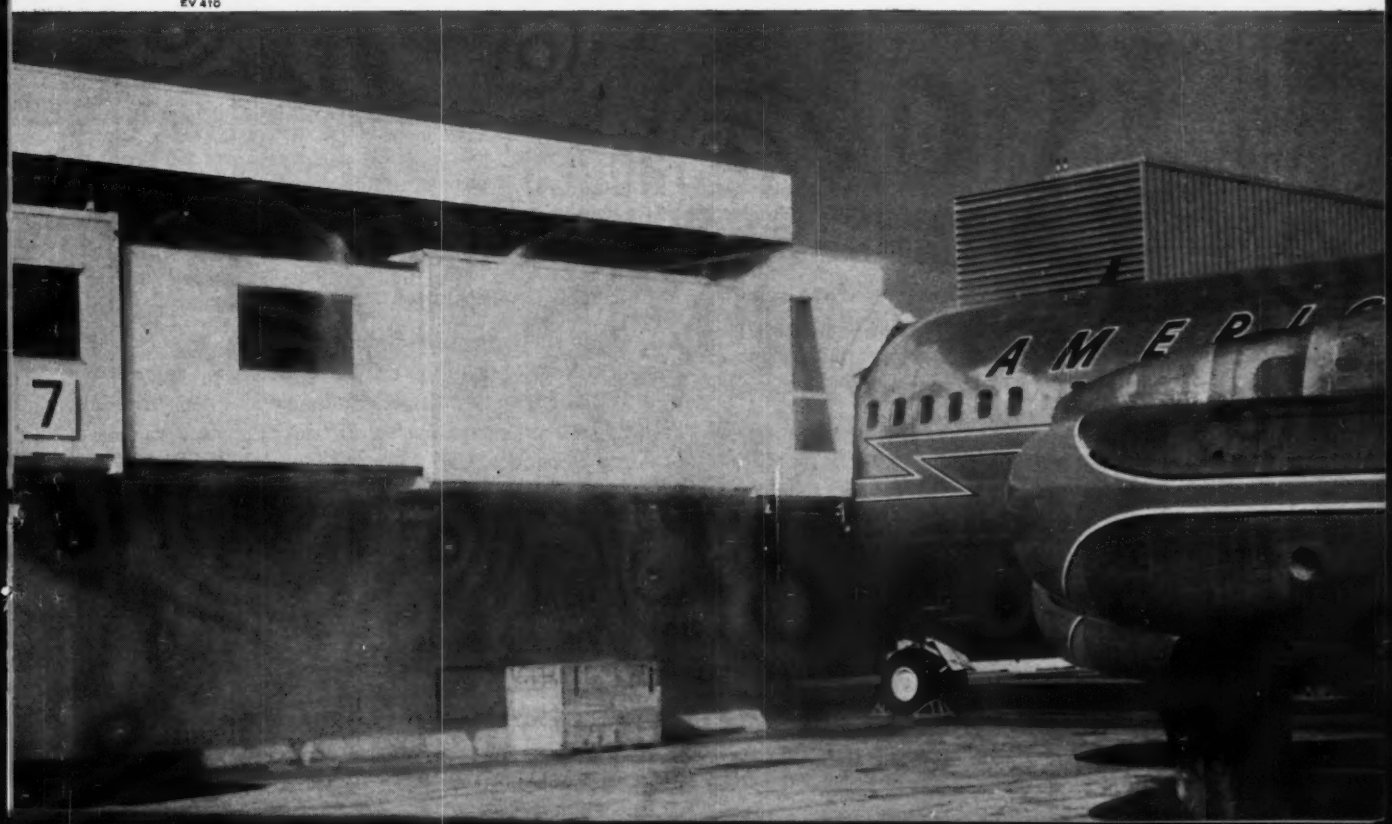
American Airlines loading bridge, shown below, gives passengers positive protection against fire with a unique deluge system.

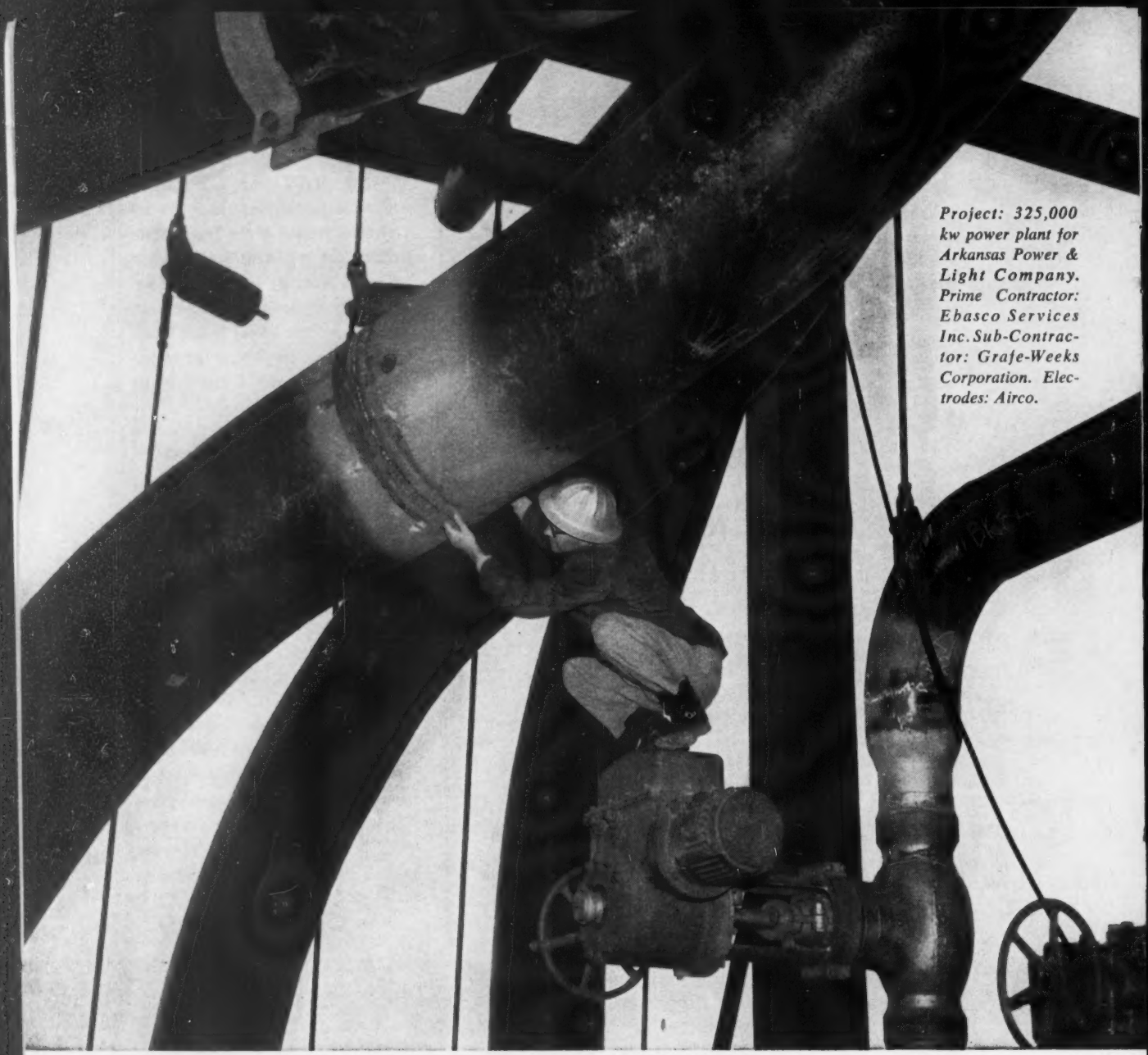
Both these fire protection systems depend on Everlasting Pendulum Stop Valves, which have been installed in thousands of critical fire protection systems over the past 35 years.

For complete information on the unique American Airlines and Empire State Building systems, write for bulletins F. They include an editorial description of both these installations and a bulletin describing Everlasting's positive action pendulum stop valves.

Everlasting also makes a line of quick-opening valves for general service, boiler blow-off, and handling viscous materials, as well as a line of cylinder-operated valves. Bulletins on all these valves are available. **Everlasting Valve Company, 45 Fisk Street, Jersey City 5, New Jersey.**

EV 410





*Project: 325,000 kw power plant for Arkansas Power & Light Company. Prime Contractor: Ebasco Services Inc. Sub-Contractor: Grafe-Weeks Corporation. Electrodes: Airco.*

# AIRCO LOW HYDROGEN ELECTRODES USED ON HIGH TENSILE PIPE WELDING *at giant new power station*

**AIRCO LOW HYDROGEN ELECTRODES** were used by Grafe-Weeks Corporation to weld the hundreds of feet of high pressure piping in the giant new steam turbine power plant of the Arkansas Power and Light Company at Helena on the Mississippi.

**Why?** . . . Because Airco low hydrogen electrodes provide an easily directed arc specifically designed to meet requirements of high pressure pipe welding . . . They also deliver X-ray quality deposits under tough conditions.

**Ask for a shop demonstration.** Would you like to see Airco electrodes put to the test? Let your Airco salesman or distributor arrange a demonstration at your convenience . . . using Airco low hydrogen electrodes or any other group of Airco electrodes. Call Airco, or look in your Classified Telephone Directory under "Welding Equipment and Supplies" for your nearest Authorized Airco Distributor.

AIRCO

**AIR REDUCTION SALES COMPANY**

**A division of Air Reduction Company, Incorporated**

**150 East 42nd Street, New York 17, N. Y.**

**More than 700 Authorized Airco Distributors Coast to Coast**

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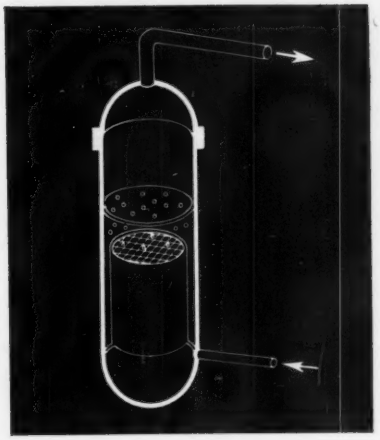
Air Reduction Canada Limited
All divisions or subsidiaries of Air Reduction Company, Inc.

For more facts circle 951 on Reader Service card, p 197



While a variety of nuclear power plants are going through their proving periods, we find continued advances being made in materials, designs, procedures and instruments for harnessing nuclear energy and radiation. If we hope to prove in nuclear power generation as an economical energy source, designers and material fabricators must continue intensive efforts at cost reductions for all components. This probably will not be done by any dramatic breakthroughs, but rather by painstaking persistence.

Associate Editor

## ● Nuclear equipment

**225** **Small-diameter tubing** for nuclear reactors is now available in 1%-zirconium-columbium, an alloy which resists oxidation better and is stronger at high temperatures than unalloyed reactor-grade columbium. Applications will be fuel-element cladding, heat-exchanger tubing. Stress-relieved at 1800 F, the alloy has these mechanical properties: maximum tensile strength, 75,000 psi; maximum yield strength (2% offset), 60,000 psi; minimum elongation (in 2 in.), 12%. —Superior Tube Company

**226** **Straight and spiral** integral-finned tubing manufactured by precision cold-finishing methods is used for nuclear fuel elements and heat exchangers. It's made in austenitic stainless steels, nickel and nickel alloys, reactive metals including titanium and Zircaloy. Finned tubing has extended surface for improved heat transfer, rigidity. Integral fin is currently supplied in straight and spiral types on outside surface of tube—up to eight fins per tube. —Superior Tube Company

**227** **Aluminum welding alloy** is now rated 'nuclear grade.' It's available in precision-spooled wire and cut rods. Alloys contain very little lithium, cadmium, boron and cobalt. Major applications may be reactor, tank and pipeline fabrication.—All State Welding Alloys Company, Inc

**228** **Fluid-monitoring system** detects and measures radioactivity in stack gases, cooling loops and effluent-fluid lines discharging to sewer or holdup tanks. It consists of a mobile sampling tank and logarithmic-count rate-meter. Two detectors operate together or separately. — Nuclear Measurements Corp

**229** **Detection** at maximum acceptable concentration levels is feature of this large-volume fluid-monitoring system. You can use with alpha and beta-gamma air-particulate monitors. System measures activity of gaseous component of the discharge from these units. Motor blower assembly is available for completely independent operation. — Nuclear Measurements Corp

## ● Nuclear-system design aids

**652** **Dresden Station,** operating nuclear-power plant, is detailed in 12-p booklet GED-4275. Results of startup test program, future of large nuclear-power-generating stations are discussed. General Electric Company

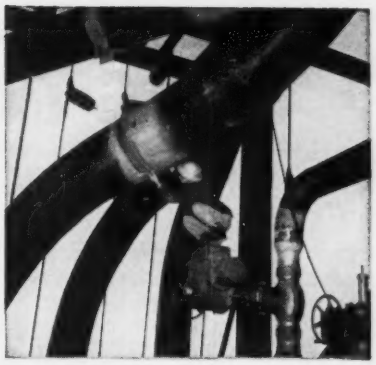
**653** **Nomograph** for computing approximate costs of building atomic-hardened structures was derived from records of actual installations. Burns and Roe, Inc

**654** **Nuclear** and atomic-power-reactor water-conditioning equipment is covered in bulletin NP-60. Hungerford & Terry, Inc

**655** **Radiation-detection** equipment is described in 4-p brochure. Integrated and individual monitoring systems are shown. Nuclear Measurements Corp

**656** **"Nuclear problems** handled with X-rays" is title of 4-p article.

continued

**For your low hydrogen welding— Airco electrodes meet every critical need**

Here are the Airco low hydrogen headliners — from a total of more than 100 Airco electrode types in more than 400 sizes and designs —

**AIRCO 312** AWS-ASTM E60-7016. For welding higher strength alloy or carbon steels. Also high sulfur content steels. Designed to overcome "underbead cracking." Lessens need for high preheat or stress-relieving postheat.

**AIRCO 396** AWS-ASTM E8016-C1. For welding the 2½% to 3½% nickel steels used in low temperature jobs. Also for nickel bearing steels, to provide uniform chemistry at joints with minimum difficulty. No high preheat needed.

**AIRCO 395** AWS-ASTM E8016-C3, A 1% nickel type of low hydrogen electrode. Also for nickel bearing steels where good low temperature properties can be attained; high sulfur content steels; grade HT and similar high tensiles.

**AIRCO 394** AWS-ASTM E10016-D2. For welding manganese-molybdenum high strength steels such as A-302 Grade B.

**AIRCO 354** AWS-ASTM E8016-B2. For welding 1.25% chrome 0.5% molybdenum steels used for pressure vessels in high temperature service; and for castings of similar analysis.

**NOW** — "Barrier Carton" bars moisture damage. Special aluminum foil interlining in new carton now protects dryness of Airco low hydrogen electrodes *8 times better than regular style carton.* If your application can't tolerate moisture damage...specify Airco.

AIRCO

**AIR REDUCTION SALES COMPANY**

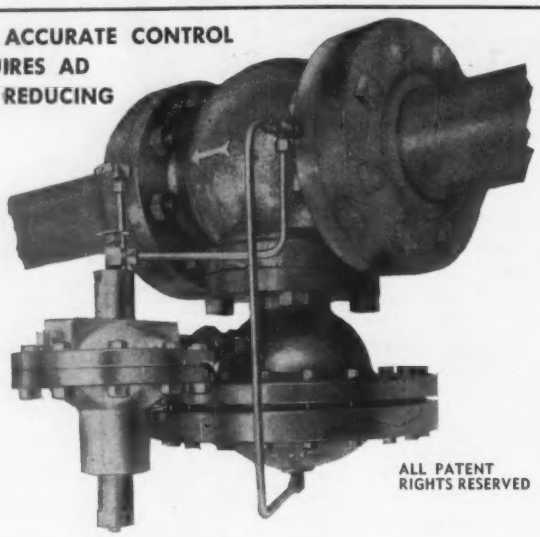
A division of Air Reduction Company, Incorporated
150 East 42nd Street • New York 17, N. Y.

circle 952 on Reader Service card, p 197

# STOP!!

## HIGH INSTALLATION & MAINTENANCE COST . . .

AND GET ACCURATE CONTROL WITH SQUIRES AD PRESSURE REDUCING VALVE



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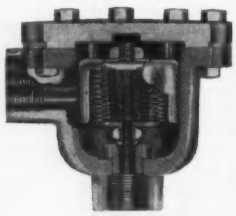
### *CHECK THESE OUTSTANDING FEATURES:*

- ☐ EASE OF INSTALLATION: All connections are made within the flanges of the main valve. Normally requires NO additional field piping.
- ☐ UNIVERSAL PURPOSE: Accurate control of steam, air, natural or other gases, water, oil or other fluids.
- ☐ EXTREMELY ACCURATE: Reacts with infinitesimal downstream pressure variation. Proportions the upstream variation quickly and accurately to control main valve and when necessary, for maximum dead-end closing.
- ☐ MINIMUM OF MAINTENANCE: Minimum working parts and connections; accessible for checking and inspection; can be reconditioned without removal from the line.

### AN ABSOLUTELY MODULATING STEAM TRAP WITH HIGHEST CAPACITY RATINGS

The Class TM Trap is truly a "condensate controller" which positively separates latent heat steam from condensate and gases.

The patented bellows design balances forces across the seat holding valve off seat to the degree of condensate in and ahead of trap—constant controlled flow—no cycling.



PATENTED

### *The Class TM Trap advantages are:*

- Increased process output and quality by more accurate process temperature
- Accellerated warm-up of Industrial process temperature
- No steam loss
- No cooling leg required
- Infinitely greater bellows life

**GET BOTH THESE QUALITY CONTROLS FROM ONE SOURCE**

**THE C. E. SQUIRES COMPANY**

*Over 50 Years of Dependability*

18502 SYRACUSE AVENUE • CLEVELAND 10, OHIO


## Nuclear systems

Procedure for analyzing uranium-fuel-alloy ingots is discussed. Philips Electronic Instruments

**657** **Nuclear data system** bulletin 101 gives specifications on 3600-point high-speed monitor for nuclear-reactor control in its 4 pp. Monitor Systems, Inc

**658** **Rod type nuclear - fuel - element** fabrication for power reactors is covered in revised 8-p bulletin GEA-6762B. Current research, testing and fuel-service programs are included. General Electric Company

**659** **Hermetically sealed valves** for pressurized - water reactor, containment of radioactive or highly corrosive liquids and gases are topics of 8-p brochure. Atomic Power Dept, United Shoe Machinery Corp

**660** **Isotope chambers** for gamma radiography are subject of 6-p brochure. Specifications for chambers using iridium 192 and cobalt 60, radiography training, consulting and engineering services are covered. Philips Electronic Instruments

**661** **Self-contained gamma alarm** system operates from 110-v circuit. Unit, outlined in 4-p pamphlet GA-2, is insensitive to electromagnetic disturbances. Nuclear Measurements Corp

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EDITOR'S NOTE: *The following bulletins may be requested directly from the manufacturer. Write on company letterhead to addresses listed below:*

★ **Condenser - tube handbook** discusses corrosion problems in the oil, utility, marine, chemical and sugar-refining industries. Available from Chase Brass and Copper Co, Waterbury 20, Conn.

★ **Air and hydraulic cylinders** are covered in three bulletins. Bulletin 204 features h-p hydraulic cylinder, 2000 to 3000 psi, bulletin 203 handles the medium-pressure, 500- to 2000-psi unit. Bulletin 202 covers air cylinders to 200 psi. Mo-Bar Hydraulics Co, Crystal Lake, Ill.

★ **Centrifugal pumps** with ranges from −350 to +1000 F and up to 1000 psig are topic of 12-p selection catalog. Dean Brothers Pumps Inc, 323 W 10th St, Indianapolis 7, Ind.

★ **Semiconductor rectifiers** are described in 24-p short-form catalog from International Rectifier Corp, 1521 E Grand Ave, El Segundo, Calif.

Begins on page 284

★ **Dc power supplies** and test instruments are subject of 16-p bulletin. Specifications are furnished with dimensions ratings. The Opad Electric Company, 43 Walker St, New York 13, N. Y.

★ **Heat exchangers** are detailed in 24-p catalog 101. Units are available in 150-, 300- and 450-lb tube- and shellside pressures; 2, 4 or 6 passes tubeside. The Griscom-Russell Co, 185 Wetmore Ave, Massillon, Ohio

★ **"Silicones** for electrical insulation" is title of 8-p publication CDS-288. Electrical and electronic applications for silicones are charted. General Electric Company, Silicone Products Dept, Waterford, N. Y.

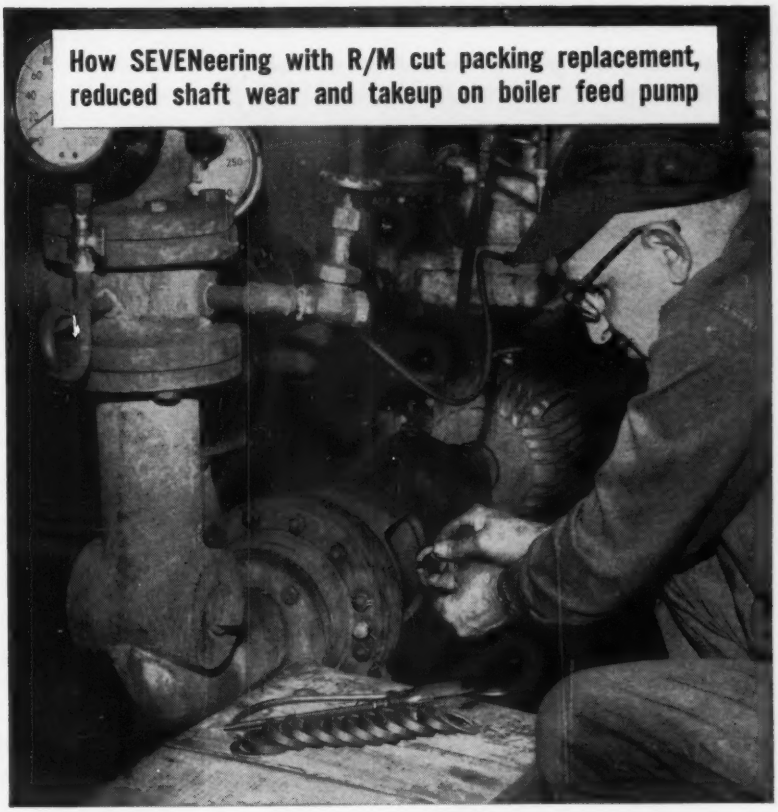
★ **Semiconductor catalog** covers over 800 devices, gives ratings, characteristics and descriptive data on silicone-glass diodes, rectifier cells, h-v cartridges, silicon-controlled rectifiers, silicon solar cells. Write on company letterhead to International Rectifier Corp, El Segundo, Calif.

★ **Hydraulic products** are topics of three catalog sections featuring tubing, fittings, hose. Applications, specs are detailed. Formite Tube Company, Two Rivers, Wis.

★ **Safety-relief-valve** catalog 301 has 100 pp, illustrates and describes firm's complete line. Capacity chart and tables, valve-service index, maintenance-equipment details, guide to corrosion-resistant properties aid selection. Crosby-Ashton, 8 Kendrick St, Wrentham, Mass.

★ **Electrical-indicating** panel instruments are covered in 24-p catalog available to engineering personnel. Electric Sales Div, DeJur-Amsco Corporation, 45-01 Northern Boulevard, Long Island City 1, N. Y.

*"You ordered a mobile transformer?"*


## Only 2 repackings a year with R/M 1845 "versi-pak"® — more than 26 with former boiler feed pump packing

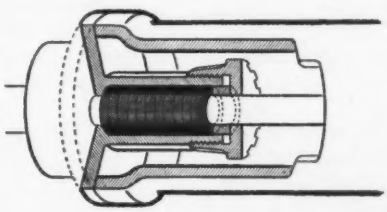
Poor packing life, expensive shaft wear, and constant takeup were all problems harassing the boiler room engineer at Ludlow Papers, Ware, Mass., in maintaining a boiler feed pump operating at 325-350°F and 3450 rpm.

The life of the braided asbestos packing formerly used was only 1-2 weeks, the shaft had to be replaced in less than a year, and too frequent packing takeup was necessary.

Maintenance Specialties Co., an R/M Big 7 Packing distributor, solved all problems fast with R/M 1845 "versi-pak" nonjacketed plastic packing. This Big 7 Type No. 1 Packing, made from long asbestos fibers combined with low-friction compounds and nonleaching lubricants, not only extended packing life to 5-6 months, but also resulted in negligible shaft wear and packing takeup. And R/M "versi-pak" costs less per set than the former packing.

Ludlow Papers, one of the largest manufacturers of gummed and coated label papers, specialty papers, reinforced papers and tapes, plastic film, and plastic coated materials, is one of many concerns Seveneering with R/M to meet their packing needs.

Our Big 7 Packing Selection Chart is a helpful guide to the selection and application of R/M Packings for all types of equipment. Write for your copy today. And the next time you need packings, see your authorized R/M Big 7 Packing distributor. He has the technical background and the packings to solve your knuckle-busting problems.



Ground-in lubrication, high resistance to heat, materials handled and pressure make R/M Big 7 Type No. 1 Packings ideal for pumps handling water, steam, chemicals, foods, beverages, oil and solvents.

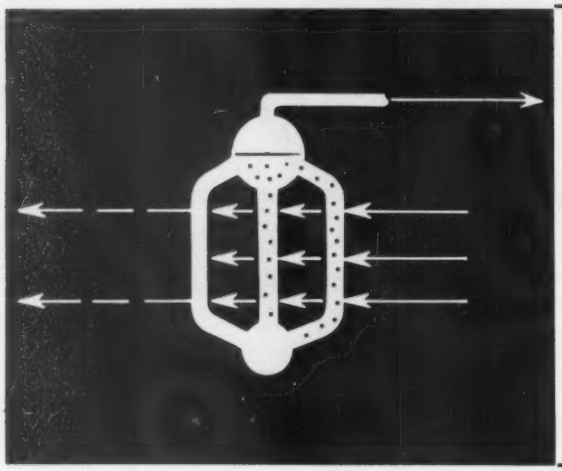
**R/M's Big 7 Packing Types meet 95% of all packing needs, are sold exclusively through authorized R/M distributors**

RM **RAYBESTOS-MANHATTAN, INC.**
**BIG 7 PACKINGS**
**PACKING DIVISION, PASSAIC, N.J.**
**MECHANICAL PACKINGS AND GASKET MATERIALS**




For more facts circle 954 on Reader Service card, p 197

# STEAM AND HOT-WATER SYSTEMS



New industries and expanding plants demand newer and better steam-plant equipment. Push to greater fuel flexibility and increased automation helps achieve minimum operating costs. But despite these modern developments there is still a place for the tried-and-proved forms of steam generation; each situation needs thorough, sophisticated study to reach the economic solution for now and the future.

In the light of new equipment available, review plant layouts periodically to spot areas of obsolescence where you can improve plant performance.

B. G. A. Skrotzki

Associate Editor

## ● Boiler equipment

**230** **Positive-flow boiler** design locates burner and furnace on the left, at horizontal center line of boiler. Side-located furnace provides most efficient circulation, according to maker. Boiler-feed injection and natural thermal circulation boost each other, produce counter-flow heat transfer—circulation pattern compares to a watertube. A packaged, automatic firetube unit, Model PF has 3-pass design with no tubes directly above or below furnace. All sizes will be available for oil, gas or combination.—Orr & Sembower, Inc

**231** **Economy boiler** has side-fired design, said to save 20% floor space. New boilers come in gas-, oil- or combination-fired models. They operate from 201,000- to 1,500,000 Btu-per-hr output at a standard 100- or 125-lb working pressure. Horizontal design puts all tubes below waterline to cut corrosion.—Eclipse Fuel Engineering Co

**232** **3-pass packaged boilers** fire gas, oil or combination, feature controlled air-atomized firing. Valve control system and dual pump and reservoir are said to deliver constant fuel supply at any oil temperature or viscosity. Enclosed control cabinet holds operating and programing flame-safeguard controls and circuit breakers.—Ray Oil Burner Co

**233** **Thrift-minded boiler** operates on waste heat from diesel engines, heating furnaces and gas turbines. Boiler comes in standard sizes from 1100 to 6100 lb of steam per hr — larger models to order. Good heating-coil designs up efficiency 10% over conventional, maker claims. Heart of the system is a series of helical tube coils in parallel rows. Inlet and outlet ends connect to distributing and collecting headers; headers attach in series to a steam drum or a boiler and circulating pump. Exhaust gas enters from below, passes radially over coils into casing, then out.—Pacific Overseas Machinery, Inc

**234** **Automatic, portable steam generator** provides own electric supply, needs only fuel and water. Oil-fired unit operates on forced-circulation principle, providing full steam pressure in about three minutes. 200-psi generator contains own gasoline-engine drive to operate electric controls.—Clayton Manufacturing Co

## ● Fuels and fuel-handling equipment

**235** **Automatic motorized mechanical-draft gas burners** feature building-block component design. Standard interchangeable parts include 4 different valve-manifold assemblies, 7 control-cabinet arrangements, 3 optional oil assemblies for standby-fuel firing. Burners come in six sizes for capacities up to 35,000,000 Btu per hr.—Mettler Co, Inc

**236** **Additives** up fuel-oil heat value. Two formulas are available, for No. 2 to 5 fuel oil, and for No. 6 or Bunker-C oil. Formula is added on top of the oil—1 gal to 1000 gal of oil, and disperses through entire supply including oil added later. Additives dissolve sludge; then sludge mixes with lighter oil so its high Btu value can also be used.—Solar Chemical Company

**237** **Sludge dispersant and combustion catalyst** helps keep strainers, burner tips, filters, oil lines and oil preheaters from clogging. A stable liquid product that you can dissolve in all residual fuel oils, Dearsol 30 improves combustion and eliminates excessive smoke and heat-wasting soot deposits. Dearsol 35, a liquid organic catalyst, helps complete fuel combustion, may be only fuel additive needed when sludge problems are not significant.—Dearborn Chemical Company

**238** **Flow switch keeps vigil** on materials, corrects or warns of flow stoppage. When flow stops, switch is automatically actuated. It will start an electromagnetic bin vibrator or stop a vibratory feeder. When switch is the energizing agent, it becomes either an audible or manual alarm system.—Syntron Company

**239** **Electric vibrator** has companion speed-regulator unit for regulating both vibration frequency and impact intensity. Just a twist of a dial lets you vary vibration frequency from 1500 to 9000 vibrations per min, impact from 9 to 300 lb. Speed regulator can mount in any position.—The Wellman Company

**240** **Vibrating feeders** feature new vibration principle. Pancake motor mounted directly on vibrator frames drives two unbalanced shafts which rotate in opposite directions. This rotation causes the motors to synchronize and produce feeding motion despite absence of direct coupling between shafts. Effective feeding of any material results. Thirty sizes are available with capacities up to 1350 tons per hr.—Link Belt Company

**241** **Conveyor scale** weighs, measures, controls flow—designed for control application in any operation where bulk materials are transported to conveyor galleries. You can also adapt it to other operations: rationing or blending additives, segregation control, determining bulk density. Remote indicating and recording instrument mounts in any convenient location up to 500 ft from carriage.—Ramsey Engineering Company

**242** **Compound keeps coal from freezing** in transit or in storage. Phosphate additive adheres to metal surfaces to provide protection against oxidation and electrochemical corrosion.—Hardy Salt Company

**243** **U-shaped immersion heaters** are for heating or keeping pumping temperatures of viscous materials for loading, blending or storage. You can also use on fluids where no steam supply is available. Fired with either gas or oil, 8-in. tube has 750,000-Btu-per-hr capacity, 10-in. has 1,250,000. New fins give higher heat-transfer rates, accelerate thermal currents within the tank, maker says. Lowered specific gravity lets material next to perforated fintube circulate freely, heat fast, rise rapidly, preventing material stratification. This keeps surface clean and free from sediment.—Brown Fintube Company

**244** **Storage-tank heater's** cast-steel headers provide high corrosion allowances. Outlet header has concave bottom; it serves as a trap to collect steam condensate, then drains it out. Finned tubes provide more heating surface per ft than bare pipe, maker states. Result: more heat transfers at lower skin temperatures, preventing coking on tubes or polymerization.—Brown Fintube Company

## ● Controls, auxiliary equipment

**245** **Ultraviolet detector** senses flame presence and operates a relay to provide alarm signal in the event of flame failure. Responsive to radiations from 2000 to 2500 A, flame detector will operate to 300 F. Since it responds only to flame it's watching and not to adjacent flames or radiation from refractories, monitor is good for individual burners in gas, oil, coal or combination-fuel-fired furnaces.—Bailey Meter Co

**246** **Thermal-conductivity gage** detects percentage of hydrogen in gas and changes in natural-gas composition requiring immediate readjustment of gas burners. Gage is available with contact-meter-relay control units which sound the alarm or protect system from gas change. Thermal-conductivity cell withstands vibration and overpressure to 3000 psig. Price: $265.—Hastings-Raydist, Inc

**247** **Compact, forward-curved centrifugal fans** are suited for systems having limited space or low noise requirements. Fans come in two models, for 300-F maximum or for 2000-F hot-air or -gas service. 2000-F fan is designed for direct furnace installation without external ductwork. They're belt-driven or direct-connected.—Garden City Fan & Blower Co

**248** **Variable axial-flow fan** for induced or forced draft or cooling has high efficiency within regulation range, continuous regulation from zero to maximum output at constant speed and minimum power consumption. Fan reaches higher than average rotational speeds with complete safety. Set of blades can be replaced in three to five hr through housing door, without rebalancing fan wheel. Standard sizes handle capacities from 50,000 to 1,100,000 cu ft per min; larger sizes produce pressures to 25-in. wg and NTP conditions. Fans operate to temperatures of 400 F; special alloy models handle 650-F operation.—Novenco Inc

**249** **Custom-built electrostatic-precipitator units** are preassembled in plant, simplifying field erection. Nonwelded flat collector-plate design lowers possibility of warping, works where resistivity is high. Results: improved clean-plate sparking voltage, increased dust-particle migration velocity to collector plate. Plate has pockets which trap and hold dust, reducing chance of re-entrainment. Unit is modular, all-welded. Structural frames, side casings, end panels and hoppers are heavy steel plate.—American-Standard Industrial Div

**250** **Corrosion-protection product** for chimneys was triggered by greater use of low-cost coal, heavy fuel oil and refinery sludge in boiler operations. It was field-tested by 24 utilities, operating with positive and negative pressures. Product protects against acids formed by sulfur dioxide, sulfur trioxide, hydrogen chloride and hydrogen fluoride.—Benjamin Foster Company

**251** **Impingement-plate scrubbers** wet-clean, absorb or cool gases. Turbulent interaction of gas and liquid does the scrubbing. Single-stage scrubber handles dust loadings at inlet up to 100 grains per cu ft, can remove suspended materials ranging from submicron fumes to dust particles in larger micron sizes. Major parts are shell, gas inlet, one or more impingement-plate stages, mist eliminator and outlet.—The W W Sly Mfg Co

**252** **Silicon rectifier** converts electrostatic precipitators now using mechanical rectifiers. Unit uses all existing equipment except rectifier motor, disk, shoes, suppressor elements and pedestal. You tie it with present ac connections and dc switchgear distributing rectified power. Rectifier has no moving parts—is cheaper than complete new power pack, says maker. Conversion is simple and fast.—Buell Engineering Co, Inc

**253** **Packaged ash-handling system** meets needs of the coal-burning plant with two to four small boilers. Ash is raked from boiler ashpit onto flat anvil plate. Dust shields keep ash from spilling on boiler floor. Pipeline's intake fittings are opened by a plug and ash is raked into the opening. Vacuum cleaning attachment comes with steam-jet or mechanical exhauster to provide vacuum for the air stream. Temporary cinder-block ash-storage bin or 7-ft-sq steel container collects ashes for removal and final dispersal.—The Allen-Sherman-Hoff Company

continued

**254** **Bulk-material conditioner** treats flyash from collection equipment or any other finely divided material, making it dustfree and manageable. Material flows continuously in the Verticone and is distributed in the form of a hollow cylinder. Inside the falling cylinder of material, a spray jet applies wetting agent uniformly to suppress dust. Three models handle 150 lb to 150 tons per hr.—The Johnson-March Corp

## Steam-system design aids for your files

Reader Service card, p 197, orders your copies

### • Boiler design aids

**662** **Boiler automation,** its status and future, is topic of 8-p study G-101. Pros and cons are weighed. Babcock & Wilcox Company

**663** **Packaged watertube boilers** are described in 4-p bulletin Ad-186. Cleaver-Brooks Company

**664** **Firetube boiler** with positive natural circulation is topic of 4-p bulletin 1275. Photos, diagrams show features. Orr & Sembower, Inc

**665** **Forced-draft packaged boilers,** Scotch type, for high- and low-pressure applications are listed in 12-p brochure 149D from American-Standard Industrial Div

**666** **Scotch marine** steam boiler plants, automatic 3-pass design, are explained with charted specs and dimensions in bulletin A-104-3. Eclipse Boiler Div

**667** **Packaged steam generators** for automatic operation are outlined in 18-p catalog AA-2760. Low-pressure air-atomizing oil burner is covered, too. Ames Iron Works, Inc

**668** **Watertube packaged boiler** with two drums, for oil or gas firing, is subject of 16-p catalog SB63. Design and construction of 5000- to 100,000-lb-per-hr units are shown. Erie City Iron Works

**669** **3-pass boilers** rated 243,000 to 1,350,000 Btu per hr are illustrated in 8-p brochure 549B. Selection data for available heating coils and i-d fans is given. American-Standard Industrial Div

**670** **Packaged boiler** features built-in heating and circulating pump and electronic control system. Unit, in sizes from 40 to 300 hp, is detailed in 8-p catalog. Boiler Div, Ray Burner Company

**671** **Side-fired boilers** with horizontal tubes totally submerged to prevent waterline corrosion are subject of 4-p circular A-103. Boiler Div, Eclipse Fuel Engineering Co

**672** **High-temperature-water** generators and their application are described in 16-p booklet 1600. Engineering data compares high-temperature water and high-pressure steam. The International Boiler Works Co

**673** **Field-erected steam generators** with 200,000 - lb - steam - per - hr capacities are illustrated in 12-p bulletin. Units take all fuels, adapt to all types of firing. E Keeler Company

**674** **Packaged boilers** are fire-tested for oil, gas or combination firing. Accessory info and dimension data are given in 8-p folder 509B. Johnston Brothers, Inc

**675** **Reference guide** to ASME Boiler Code (section VIII) is available as handy wall chart from Missouri Boiler and Tank Company

### • Fuels and fuel handling

**676** **Checking air pollution** at the local level is discussed in 20-p brief. Chapters include legislation, training personnel. Air Pollution Control Div, John Wood Company

**677** **Crushing handbook** has 40 pp, discusses impact-, attrition-, shear- and pressure - reduction methods. Closed-circuit crushing systems are covered, diagrams and chart included. Pennsylvania Crusher Div of Bath Iron Works Corp

**678** **Liquid fuel-oil additive,** used throughout system from storage tank to burner, reduces soot formation. Bulletin 461 is available from Universal Refining Products Company Inc

**679** **Crushers,** complete line, are covered in bulletin 4020. Applications of each type are explained. Pennsylvania Crusher Div of Bath Iron Works Corp

**680** **Packaged incinerator burners** with input capacities to 900,000 Btu per hr are depicted in 4-p circular. Selection and sizing info is included. Combustion Div, Eclipse Fuel Engineering Co

**681** **Hot-water** storage-tank heaters are cement- and copper-lined types. 16-p catalog 602 includes piping diagrams and heating-capacity charts. Old Dominion Iron & Steel Corp

**682** **Storage-water heaters** are topic of 8-p bulletin 61. Specs cover 55 sizes in both vertical and horizontal models, 114 sizes of removable U-tube heating elements. Niagara Weldments Inc

**683** **Bucket-elevator-system** selection and application are subjects of 84-p manual be-55. Centrifugal and perfect-discharge continuous-bucket-elevator specs are charted. Webster Manufacturing, Inc

**684** **Wet drum separators** available in concurrent and counter-rotation styles are topic of 4-p circular. Stearns Magnetic Products

**685** **Continuous blending** of fuel oil to attain desired viscosity is subject of 4-p folder 90-29-03. Fischer & Porter Co

**686** **Valve connects gas line** to burner, incorporates long shaft for quick, leaktight connections — subject of catalog from Mechanical Products Corporation

**687** **Automatic coal scale** is topic of 8-p reference bulletin 0359. Engineering and 3 - dimensional drawings, dimension sheets are given. Richardson Scale Co

**688** **Vibrating feeders** are described in 6-p folder 2770. Link-Belt Company

**689** **Deep-trough belt-conveyor idlers** are topic of 8-p book 2716A. Selection data covers 60 35-deg deep-trough idlers, additions to 45-deg-idler line. Link-Belt Co

**690** **"How to plan** and install your own conveying system" is title of 20-p guide 500. Typical installation plans and check list to help select right conveyors are features. Conveyor Systems, Inc, A B Farquhar Div

**691** **Light, medium and heavy** conveyors are discussed in 8-p illustrated brochure. Syntron Co

**692** **Bucket elevators** for handling bulk materials are topic of 22-p booklet. Chapters deal with belt selection, splicing and trouble-shooting. Tables cover steel buckets. Hewitt-Robins Inc

**693** **Steel-belt-conveyor** applications are depicted in 8-p booklet. Sandvik Steel, Inc

**694** **Cradle idler** and belt conveyor are topics of brochure 660. Dimensional drawings, capacity tables included. The McNally Pittsburgh Mfg Co

**695** **Indirect-fired heaters** for gas, steam, transfer oil and light and heavy liquids are discussed in 8-p catalog 400. Low metal-wall temperature in heater eliminates refractories. Brown Fintube Company

**696** **Screw-conveyor drive** is subject of 4-p folder 2718. Sizes for screw diameters, selection data are listed. Link-Belt Company

**697** **Trackside shakeout** is topic of 4-p folder 172. Pushbutton controlled, unit has 7½-hp vibrator drive. Hewitt-Robins Inc

## • Auxiliaries and controls

**698** **Air-driven soot blower** is described in 8-p bulletin 1073. Diagrams cleaning pattern of dual-motor drive and multihelix jet paths. Copes-Vulcan Div, Blaw-Knox Co

**699** **Retractable soot blower** has electric drive. 8-p bulletin 1063 diagrams double-helix-path cleaning. Copes-Vulcan Div, Blaw-Knox Co

**700** **Jet blowers** use compressed air or steam pressure to move ventilation or circulation air; blast nozzles are used in ducts and stacks at very low drafts. 8-p bulletin 4AB is offered by Schutte and Koerting Company

**701** **Rotary soot blowers,** air powered, electric and manually operated, are topic of bulletins 1067, 1071 and 1072. Copes-Vulcan Div, Blaw-Knox Co

**702** **Filtering steam condensate** in supercritical generating stations—focal point of 8-p filter booklet. Croll-Reynolds Engineering Co

**703** **Airfoil centrifugal fans** for furnaces, packaged boilers and air drying are available in capacities from 15,000 to 450,000 cfm. 4-p booklet 1122 is available from Westinghouse Electric Corporation, Sturtevant Div

**704** **"Design fundamentals** for combustion-air blowers" is title of 8-p reprint. Included are performance curves and illustrations on selection of gas boosters and blowers. The Spencer Turbine Co

**705** **Combustion-air heaters** are topic of 4-p publication FD 800. Steam-heating-coil and hot-water-coil designs are discussed. Buffalo Forge Company

**706** **Steam converters** for steam-heating water are covered in 20-p file 1460. Charts aid selection. Dunham-Bush, Inc

**707** **Preventing** tube failures in high-pressure steam generators is examined in 8-p booklet. Dow Industrial Service Div

**708** **Magnesite-chrome basic brick** has dimpled metal jacket to provide built-in expansion — shown in literature from H K Porter Company, Inc, Refractories Div

**709** **H-t mortar** for boiler-brickwork installation and repair—covered in bulletin 602. Temperatures and quantities — amount needed for trowelling, dripping and brushing—are included. J H France Refractories Company

**710** **Fire-clay refractories** are featured in 8-p brochure. Firm's principal brands are described. Harbison-Walker Refractories Co

**711** **Design and selection** of combustion-control systems is detailed in 32-p bulletin 1001. Proportioning and metering systems are diagramed. Reliance Instrument Div, Electro-Mech Corp

**712** **"How refractories work** for industry" is title of 16-p report covering raw materials, research and production of refractories. Harbison-Walker Refractories Co

**713** **Electronic combustion controls**—oxygen analyzers, flowmeters, interlock switches and flame-safety equipment—are reviewed in 20-p bulletin 1002. Reliance Instrument Div, Electro-Mech Corp

**714** **Triple-fuel** draft control for oil-, gas- and coal-fired furnaces and boilers is topic of 4-p guide. Heating- and processing-equipment applications are subject of 12-p booklet. Field Control Div, Conco Engineering Works, Inc

**715** **Combustion controls** for furnaces, ovens and boilers are illustrated in 8-p catalog 3-001. Gas and furnace pressure, ratio and flow control are discussed. The North American Mfg Company

**716** **Safety system** for plants using gas is described in 12-p supplemental bulletin 22. Safety-shutoff valves and supervising gas cocks are mainsprings of this system. The North American Manufacturing Company

**717** **Boiler-blowdown control,** electronically automated, is described in brochure. Includes external, internal views. Boilertrol Corp

**718** **Operation and control** of high steam temperatures — diagramed in 4-p folder 543. Curves show effects of control. Bailey Meter Co

**719** **Control systems** for boiler cleaning are described in 14-p booklet. Specifications and control-panel combinations are features. Diamond Power Specialty Corp

**720** **Acid-resistant-product** test methods and results are subject of 6-p folder. Protects brick, steel and concrete chimneys of plants using high-sulfur fuels. Benjamin Foster Company

**721** **Packaged oil burner,** pressure-atomizing type, is topic of 4-p bulletin 100A. National Airoil Burner Co, Inc

**722** **Firing equipment** for gas, oil, coal is covered in 12-p bulletin AIA 30-C-1. Iron Fireman Manufacturing Company

**723** **Dust and fume control** equipment is cataloged in 16-p brochure G-100. Electrical precipitators, filters, scrubbers, processors, heaters and mechanical collectors are covered. Western Precipitation Div, Joy Manufacturing Co

**724** **Combustion-control systems** for gas-fired boilers are diagramed with description of each. 16-p bulletin MSA-116A is available from Hagan Chemicals & Controls, Inc

*This 25' Ljungstrom rotor will contain a total heating surface of 128,000 sq ft. Continuous heat recovery by this unit will boost the temperature of incoming combustion air from 100°F to 585°F. Every 45-50°F thus returned as preheat increases boiler efficiency about 1%.*

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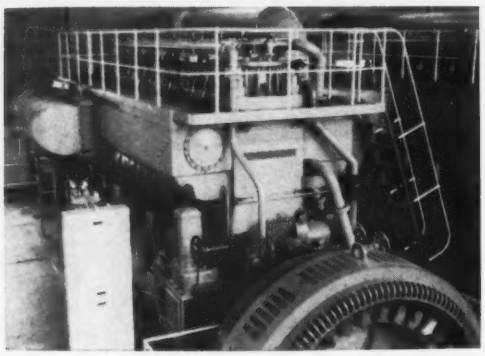

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| HP | RPM | MAKE | VOLTS | TYPE |
|---|---|---|---|---|
| 2500 | 257 | G.E. | 6600 | MT-28 |
| 1000 | 1200 | Al.-Ch. | 4000 | ANY |
| 1000 | 900 | Al.-Ch. | 2300 | ANY |
| 700 | 720 | G.E. | 440 | I-M |
| 600 | 1800 | G.E. | 4160 | M-6345 |
| 500 | 1200 | G.E. | 440 | M-6345Z |
| 400 | 1200 | West. | 2300 | CW |
| 400 | 720 | G.E. | 440 | MT-573Y |
| 350 | 1800 | Al.-Ch. | 2300 | ARYW |
| 300 | 900 | G.E. | 440 | IM-17 |
| 300 | 450 | G.E. | 440 | IM-16 |
| 250 | 600 | West. | 2300 | CW-1000 |
| 200 | 514 | West. | 2300 | CW-950A |

**MOTOR GENERATOR SETS**

| KW | MAKE | A.C.V. | D.C.V. |
|---|---|---|---|
| 1750 | G.E. | 4160/2300 | 250/300 |
| 1250 | West. | 4160/2300 | 250 |
| 1000 | West. | 4160/2300 | 250 |
| 750 | G.E. | 4160/2300 | 250 |
| 600 | G.E. (3 unit) | 2300/440 | 125/250 |
| 500 | G.E. | 2300 | 250 |
| 400 | Al.-Ch. | 2300/440.. | 125/250 |
| 250 | G.E. | 2300 | 250 |
| 200 | G.E. | 2300 | 250 |
| 150 | West. | 440 | 250 |

**D. C. MOTORS**

| HP | RPM | MAKE | VOLTS | TYPE |
|---|---|---|---|---|
| 1500 | 300 | West. | 250 | TEFV |
| 850 | 250/500 | West. | 250 | QM |
| 600 | 250/500 | G.E. | 600 | DBL. ARM. |
| 500 | 210 | G.E. | 250 | MCF |
| 400 | 1150 | REL. | 250 | T-1970 |
| 400 | 300/900 | G.M. (2) | 250 | D4D |
| 300 | 575/1150 | West. | 250 | CB-500 |
| 200 | 700 | West. | 250 | SK-201 |
| 150 | 280/1000 | G.E. | 250 | MCF |
| 150 | 1150 | G.E. (2) | 250 | BC-37 |
| 150 | 400/530 | West. | 250 | SK-201 |
| 100 | 400/800 | G.E. | 250 | MPC-6 |
| 100 | 575 | G.E. | 250 | CD-147 |

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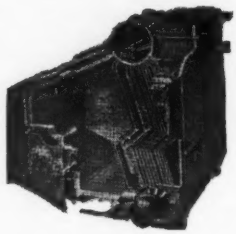

| #Steam/hr. | Key | PSI | Temp. |
|---|---|---|---|
| 122,500 | DF | 565 | 850 |
| 121,650 | DF | 565 | 850 |
| 60,000 | SF | 435 | 750 |
| 74,000 | H | 280 | 500 |
| 55,000 | A | 240 | — |

DF Double Furnace, SF Single Furnace (Illustrated), bent water tube boilers w/economizers and superheaters, B & W's and Foster Wheelers.

H Header type, straight tube, B & W.

A 3 drum, single furnace, Wickes.

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## FOR SALE

**2 Westinghouse Turbo Generator Sets**

312 KVA each—Initial Stm. 150 PSIG—Exhaust Stm. 5 PSIG—Electrical Conditions 3/60/2400V Surface Cond.—Westinghouse Switchboard, fully metered—New in 1947—$75,000 complete—will consider terms.

**CARLETON LICHTY**
Hotel Del Coronado, Coronado, Calif.

Circle 11S on Reader Service Card

# THE BOSTON METALS COMPANY

*Oldest Shipbreaking Firm in the U.S.A.*

## OFFERS NEW EQUIPMENT FROM THE UNCOMPLETED

# BATTLESHIP U.S.S. KENTUCKY

***Equipment installed but never used—all built to Navy standards of finest materials***

## TREMENDOUS SAVINGS ON ALL EQUIPMENT:

## PUMPS

★ **10 MAIN FEED PUMPS—$3250.00 EACH**
*PUMP:* Ingersoll-Rand — size 5" — three stage — capacity 500 GPM at 750# discharge pressure. B.H.P. 330 — 5000 RPM. *TURBINE:* Worthington-Moore — design pressure 575#/sq.inch — non-condensing—back pressure 20# — 5000 RPM — 330 B.H.P.

★ **GEARED TURBINE DRIVEN MAIN FEED BOOSTER PUMPS — $1250.00 EACH**
*PUMP:* Mfg. by Buffalo Pump Co. — vertical single stage — capacity 550 GPM — 30# discharge — 8" suction — 5" discharge. *TURBINE:* 1 stage impulse — type Y-W — vertical — design steam pressure #575 — back pressure 20# — 12.5 HP — 5500/1750 RPM — mfg by Terry Steam Turbine Co.

★ **2 MAIN FEED BOOSTER PUMPS—$1350.00 EACH**
Same as geared turbine-driven main feed booster pumps above, but with 14.5 HP 440/3/60 AC Star motor & Ward Leonard Control. Across-the-line starter with pushbutton.

★ **8 GEARED TURBINE DRIVEN VERTICAL CONDENSATE PUMPS — $1950.00 EACH**
*PUMP:* Main condensate 2-stage vertical pump — mfg by Buffalo Pump Co. CAPACITY: 375 GPM — 70#/sq.inch discharge pressure — 1150 RPM — 22.5 BHP — 9" suction — 4" discharge. *TURBINE:* Single stage — 575# working pressure — 20#/sq.inch back pressure — 22.5 HP — 5360/1150 RPM — Mfg. by Terry Turbine Co.

★ **2 AUX. FEED BOOSTER PUMPS—$1250.00 EA.**
*PUMP:* Vertical—mfg by Buffalo Pump Co. — 200 GPM — 30# discharge pressure. *MOTOR:* 7.36 HP — 1800 RPM — 440/3/60 — Star Motor, with control.

★ **BRONZE RECIPROCATING STANDBY FEED PUMPS — $1850.00 EACH**
11 x 11 x 18 — mfg by M. T. Davidson Co. — vertical simplex — capacity 180 GPM — 800-900# discharge pressure — 575# working pressure.

★ **4 TURBINE-DRIVEN FIRE AND FLUSHING SERVICE PUMPS — $2150.00 EACH**
*PUMP:* Worthington — horizontal centrifugal. Fire Service: 750 GPM capacity — 150 PSI discharge pressure — 3500 RPM. *TURBINE:* single impulse — type B-20 — mfg by B. F. Sturtevant — design steam pressure 575# per sq. inch non-condensing. Back pressure 15# — B.H.P. 80/90

★ **3 GEARED TURBINE-DRIVEN MAIN CIRCULATING PUMPS (Price on request)**
*PUMP:* Mfg by Worthington Pump & Machinery Co. — 28" type — vertical single stage — bronze. Capacity: 28,000 GPM — discharge pressure 13.5# — 600 RPM — 267 BHP — 28" suction — 28" discharge — 8.5:1 gear ratio. *TURBINE:* single impulse — vertical type — 575# design steam pressure non-condensing — back pressure 15#/sq.inch. RPM 5100 pinion — 600 gear. Reduction gear ratio 8.5:1 — 267 BHP — mfg by B. F. Sturtevant.

★ **3 MOTOR-DRIVEN MAIN CONDENSATE PUMPS — $2250.00 EACH**
Mfg. by Buffalo Pump Co. — verical 2-stage — 375 GPM — 70#/sq.inch discharge pressure — 1150 RPM. Motor Data: 25 HP — 440/3/60 — 1150 RPM — Star Electric Motor Co. — with across-the-line starter, with push-button station — mfg by Ward Leonard

★ **8 GEARED TURBINE-DRIVEN MAIN LUBE OIL PUMPS — $2150.00 EACH**
Mfg by Northern Pump Co. *PUMP:* Vertical rotary type — 750 GPM — 55#/sq.inch discharge pressure — 263 RPM — 35 BHP — oil viscosity 130 to 500 S.S.U. — 7" suction — 6" discharge. *TURBINE:* Single stage — 575# design pressure non-condensing — exhaust pressure 15# — 35 BHP — 26.39:1 gear ratio — 6940 RPM.

★ **FUEL OIL TANK DRAIN PUMPS — $650.00 EACH**
Northern — 50 GPM at 50 PSI — 426 RPM. *MOTOR:* 5 HP — 440/3/60 — 1750 RPM — with control.

★ **4 TURBINE-DRIVEN GEARED FUEL OIL BOOSTER & TRANSFER PUMPS — $1850.00 EA.**
Mfg by Northern Pump Co. — vertical rotary — 300 GPM — 150# discharge pressure — 282 RPM — 47.3 BHP — Oil viscosity 70-700 S.S.U. — 7" suction — 5" discharge. *DRIVE:* single stage impulse — 575# non-condensing — 15#/sq.inch discharge pressure.

★ **FUEL OIL SERVICE PUMPS — $900.00 EA.**
Mfg by Northern Ordinance Co. *PUMP:* Size 4840-60 — 27.4 BHP — 85 GPM — 350 PSI pressure — 560 RPM — 19.5" HG suction lift. *TURBINE:* Northern Ordinance — 27.4 HP — 575 PSI at 15 lbs. exhaust — 70040 RPM/gear 560 RPM. Non-condensing — no superheat.

★ **STANDBY FUEL OIL SERVICE PUMPS — $490.00 EACH**
*PUMP:* Northern Pump. Co. — 10 GPM at 350 PSI — 200 RPM. *MOTOR:* 5 HP — 440/3/60 — 1750 RPM gear motor drive to 200 RPM with magnetic starter.

★ **BRONZE $750 GPM FIRE PUMP — $2900.00**
750 GPM — 150 PSI — horiz. split casing — 8" x 16". *MOTOR:* 117 HP — 440/3/60 — 3550 RPM — 140 amps — Westinghouse — frame W-505 — with magnetic starter and valves.

★ **MOTOR-DRIVEN FUEL OIL BOOSTER & TRANSFER PUMPS — $3450.00 EACH**
*PUMP:* Northern Ordinance Co. — size 3060-60 — BHP 47.3 — 300 GPM at 150 lbs. — 288 RPM — 1.291 displacement. *MOTOR:* Reliance Electric Co. — 51.5 HP at 1750 RPM; 34.3 at 1160 RPM; 25.7 at 875 RPM. 440/3/60 — temp. rise 65°C. Gear-type heavy duty 4-speed motor & control cabinet.

## MISCELLANEOUS

★ **3 UNUSED MOTOR-DRIVEN AIR COMPRESSORS — $2750.00 EACH**
Mfg by Worthington — 2-stage 250 CFM. Free air at 200 lbs. at 655 RPM. MOTOR: 96 HP — 440/3/60 — 3600 RPM 114 amps. *REDUCTION GEAR:* 3600 RPM to 655 RPM compressor speed. Motor mfg by Diehl — with magnetic controllers & spare parts. Typical serial nos: Compressor L-44464; Motor 869426. Priced to sell.

★ **LUBE OIL COOLERS — $2250.00 EACH**
1625 sq.ft. — 826 Cu-Ni tubes — W.P. shell 75 PSI — tubes 75 PSI — single pass.

★ **FUEL OIL HEATERS — $450.00 EACH**
Griscom-Russell—sectional 9-fin — max oil pressure 350 lbs. — test 750 PSI. Steam 618 PSI — test 1000 PSI — Size QUAD-AT-60.

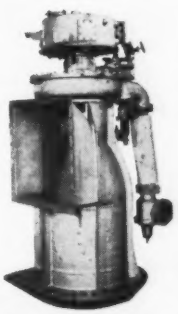
★ **LUBE OIL COOLERS**
4—mfg by Westinghouse. 1600 sq.ft. cooling surface — cylindrical straight tube horizontal type. Oil capacity 590 GPM — water capacity 1500 GPM — emp. oil inlet 150°F — outlet 120°F — temp. water inlet 85°F — outlet 90°F. Number of 5/8" tubes 816 — wall 0.049 TK — Cupro-Nickel

**6" BRONZE DUPLEX STRAINERS**

**BRONZE GATE VALVES — 36" INJECTION**

## 20 TURBINE DRIVEN FORCED DRAFT BLOWERS

### mfg. by B. F. Sturtevant Co.



**PRICED TO SELL**

**$950.00 EACH**

With turbine throttle pressure of 575# dry saturated steam and 15# back pressure, the following performance table applies:

| CFM | STATIC PRESSURE | RPM | H.P. | LBS./HOUR |
|---|---|---|---|---|
| 29,500 | 35" | 5540 | 250 | 8250 |
| 22,500 | 21.50" | 4280 | 117 | 3978 |
| 19,350 | 14.80" | 3600 | 69 | 2829 |
| 22,100 | 8.80" | 3385 | 57 | 2508 |
| 21,000 | 7.75" | 3220 | 48 | 2209 |
| 14,750 | 8.95" | 2780 | 32 | 1760 |
| 14,000 | 8.05" | 2640 | 27 | 1620 |
| 15,000 | 4.00" | 2310 | 18 | 1260 |

The blowers will deliver heir rated capacity at 460# dry saturated steam and 15# back pressure. Units are vertical, with 30¼" alloy steel propeller fan. V-C-7 turbine—built to high Navy standards. Each wheel is machined from a single forging with the buckets milled into the rim. Spare parts furnished with each fan.

# THE BOSTON METALS COMPANY

**313 East Batimore Street**
**Phone: ELGIN 5-5050**

**Baltimore 2, Maryland**
**Phone: LEXINGTON 9-1900**



Circle 12S on Reader Service Card

# RE-NU-BILT ELECTRICAL EQUIPMENT

## 53 YEARS SERVICE

### MOTOR GENERATOR SETS

| Qu. | KW | MAKE | RPM | AC VOLTS | DC VOLTS |
|---|---|---|---|---|---|
| 2 | 4800 | G.E. | 450 | 2300/4600 | 250/300 |
| 1 | 2500 | WHSE. | 720 | 2300/4160 | 600 |
| 1 | 2100/2400 | G.E. | 450 | 2300/4600 | 250/300 |
| 2 | 1750/2100 | G.E. | 514 | 2300/4600 | 250/300 |
| 1 | 2000 | G.E. | 514 | 2300/4600 | 600/666 |
| 1 | 1500 | G.E. | 720 | 13200/6600 | 600 |
| 1 | 1250 | WHSE. | 720 | 2300/4000 | 600 |
| 1 | 1000 | G.E. | 900 | 2300/4000 | 600 |
| 1 | 1000 | G.E. | 900 | 6600/4000 | 260 |
| 1 | 1000 | G.E. | 720 | 2300/4000 | 275 |
| 1 | 500 | G.E. | 900 | 2300/4600 | 250 |
| 1 | 500 | G.E. | 900 | 440 | 250/125 |
| 2 | 300 | G.E. | 1200 | 2300 | 275 |
| 1 | 300 | WHSE. | 1200 | 2300/4100 | 600 |
| 1 | 300 | G.E. | 1200 | 2300/4160 | 250 |

### FREQUENCY CHANGER SETS

| Qu. | KW | MAKE | FREQ. | VOLTAGES |
|---|---|---|---|---|
| 1 | 12500 | WHSE. | 60 To 25 | 13200-13200 |
| 1 | 5000 | G.E. | 60/50/60 | 11000-6600 |
| 1 | 2500 | G.E. | 60/24/60 | 2400-2400 |

### 3 PHASE 60 CYCLE MOTORS SLIP RING

| Qu. | HP | MAKE | TYPE | VOLTS | SPEED |
|---|---|---|---|---|---|
| 1 | 1750 | G.E. | M-570BS | 4800/2400 | 1800 |
| 1 | 800 | WHSE. | CW | 550/2200 | 1776 |
| 1 | 600 | WHSE. | CW-32D | 440 | 1778 |
| 1 | 600 | WHSE. | CW | 440 | 850 |
| 1 | 550 | WHSE. | CW | 440 | 252 |
| 1 | 500 | WHSE. | CW | 2300 | 881 |
| 1 | 500 | WHSE. | CW | 550/2300 | 350 |
| 1 | 300 | AL. CH. | ANY | 2200 | 720 |
| 1 | 300 | GEN. EL. | MTP-561 | 2200 | 1760 |

### SQUIRREL CAGE

| Qu. | HP | MAKE | TYPE | VOLTS | SPEED |
|---|---|---|---|---|---|
| 3 | 1500 | G.E. | K.D.P. | 2300 | 3580 |
| 1 | 1000 | AL. CH. | ANW | 2300 | 1180 |
| 2 | 500 | WHSE. | CSP-583H D.P. | 440 | 3600 |
| 1 | 500 | AL. CH. | ARW-D.P. | 2300 | 3600 |
| 3 | 500 | Whse. | CS-1216 | 2200 | 500 |
| 1 | 450 | EL. | FR3910 | 2200 | 1185 |
| 1 | 400 | WHSE. | C87151 | 6600 | 3565 |
| 1 | 300 | Cont. | NL686, D.P. | 440 | 1780 |

### OUTDOOR G.E. METAL CLAD SWITCHGEAR

600 V. 3 POLE, A.C.B.

1—3000 AMP., AL-2-75, ELEC. OPER
1—1000 AMP. AL-2-50, MANUAL
4— 800 AMP, AL-2-50 MANUAL
1— 400 AMP., AL-2-50 MANUAL
3—SPARE COMPARTMENTS

### PUMPS — MOTOR DRIVEN

4—600 G.P.M. Gould, Figure 3360, 8 Stage, 2310 Ft. Head, 1000#, 3550 RPM, Each coupled to 500 HP 3-60-3350 RPM D.P. Sq. Cage Motor

2—WHSE, Type CSP-583H, 440 volt

1—Allis Ch. 2300 V.

## BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.

Phone: OL 3-3334—N.Y.C. RE 2-7150

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### A. C. MOTORS—60 CYCLE

| HP | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 800 | Whse. (2) | Sq. Cage | 2300 | 1800 |
| 750 | El. Machy. | Synch. | 480 | 514 |
| 700 | G.E. | Slipring | 2300 | 400 |
| 700 | G.E. | Slipring | 2300 | 514 |
| 600 | G.E. | Synch. | 2300 | 514 |
| 600 | G.E. | Synch. | 480 | 900 |
| 600 | Elliott (2) | Sq. Cage | 2300 | 900 |
| 600 | Whse. | Slipring | 2300 | 360 |
| 500 | G.E. | Slipring | 2300/4000 | 514 |
| 500 | G.E. b.b. (2) | Synch. | 2300/440 | 1200 |
| 450 | Allis Ch. | Sq. Cage | 2300/440 | 720 |
| 400 | G.E. Vertical | Sq. Cage | 2300 | 720 |
| 400 | Allis Ch. | Slipring | 2300 | 900 |
| 400 | Whse. | Sq. Cage | 2200 | 514 |
| 400 | Marathorn (2) | Sq. Cage | 2300 | 3600 |
| 400 | G.E. | Slipring | 2200/440 | 600 |
| 400 | G.E. | Synch. | 550/2200 | 400 |
| 400 | Whse. | Sq. Cage | 440 | 1200 |
| 350 | Allis Ch. (2) | Slipring | 2300 | 450 |
| 350 | G.E. | Slipring | 440 | 900 |
| 350 | El. Machy. | Synch. | 2300 | 900 |
| 300 | G.E. | Slipring | 220/440 | 514 |
| 250 | G.E. | Sq. Cage | 440 | 1200 |
| 250 | Gen. Elec. | Sq. Cage | 440 | 3600 |
| 250 | Whse. | Sq. Cage | 2300/440 | 600 |
| 250 | Whse. (4) | Slipring | 2300/440 | 600 |
| 200 | G.E. | Slipring | 550/440 | 1200 |
| 200 | G.E. b.b. | Sq. Cage | 220/440 | 720 |
| 200 | G.E. | Slipring | 220/440 | 450 |
| 200 | G.E. | Slipring | 440 | 600 |
| 200 | G.E. | Slipring | 2200 | 900 |
| 200 | Reliance b.b. | Sq. Cage | 220/440 | 1800 |
| 200 | Allis Ch. | Slipring | 2200/440 | 720 |
| 200 | G.E. | Sq. Cage | 2300 | 450 |
| 150 | Whse. b.b. | Sq. Cage | 440 | 1800 |
| 150 | Whse. XP | Sq. Cage | 440 | 3600 |
| 150 | G.E. (4) | Slipring | 2200/440 | 600 |
| 150 | Whse. | Slipring | 220/440 | 1200 |
| 150 | G.E. | Sq. Cage | 2200/440 | 600 |
| 125 | Star b.b. | Sq. Cage | 220/440 | 900 |
| 125 | A.C. TEFC | Sq. Cage | 220/440 | 1800 |
| 125 | El. Machy (2) | Synch. | 220/440 | 400 |
| 125 | G.E. TEFC | Sq. Cage | 2200 | 3600 |
| 125 | Al. Ch. TEFC | Sq. Cage | 220/440 | 600 |
| 125 | G.E. (2) | Slipring | 220/440 | 514 |
| 100 | Star b.b. | Sq. Cage | 220/440 | 600 |
| 100 | Allis Ch. | Slipring | 2300/440 | 600 |
| 100 | G.E. TEFC | Sq. Cage | 220/440 | 1200 |
| 75 | A.C. TEFC | Sq. Cage | 2300/440 | 1200 |

### D. C. MOTORS

| HP | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 350 | G.E. | MPC | 250 | 900/1200 |
| 250 | Cr. Wh. | 101-E | 230 | 1150 |
| 200 | Whse. b.b. | SK | 250 | 287/575 |
| 150 | Reliance b.b. | 1050-T | 230 | 1150 |
| 150 | Rel. TEFC b.b. | 2550-F | 230 | 850 |
| 125 | G.E. | CD-173 | 230 | 575/1150 |
| 100 | Reliance b.b. | 1050-T | 230 | 600/1200 |
| 100 | Elliott b.b. T.E. | JH-FE | 230 | 1150 |
| 100 | El. Dyn. b.b. (2) | 30-S | 230 | 450/1200 |
| 75/100 | Whse. | SK-191 | 230 | 300/900 |
| 60 | G.E. TEFC b.b. | CD-135 | 230 | 1150 |
| 40/50 | Whse b.b. | SK-173 | 230 | 300/1200 |

### MOTOR-GENERATOR SETS

| KW | Mfr. | Input | Output V |
|---|---|---|---|
| 600 | Allis Ch. | 440 AC | 250 DC |
| 300 | G.E. | 440 AC | 250/350 DC |
| 200 | Allis Ch. (2) | 440 AC | 250 DC |
| 200 | Whse. synch. | 220/440 AC | 55 DC |
| 200 | Gen. Elec.* | 220/440 AC | 125 DC |
| 100 | Delco b.b. | 220/440 AC | 120/240 DC |
| 75 | Whse. Synch. | 220/440 AC | 250 DC |
| 75 | Elec. Prod. | 220/440 AC | 125 DC |
| 50 | G.E. | 220/440 AC | 250 AC |

## Arthur Wagner Co.

Certified

MO nroe 6-7409

1435 W. RANDOLPH ST

CHICAGO 7, ILLINOIS

Circle 15S on Reader Service Card

### TRANSFORMERS—60 CYCLE

| QU. | KVA | MAKE | TYPE | PHASE | VOLTAGE |
|---|---|---|---|---|---|
| 2 | 3000 | Moloney | TCR | 3 | 7200-4160/2400 |
| 2 | 3000 | G.E. | OA-T | 3 | 26,400-4160/2400 |
| 3 | 100 | G.E. | Pyranol | 1 | 2400/4160-240/480 |
| 2 | 1000 | Mol. | | 3 | 13800-4000/2300 |
| 3 | 500 | G.E. | K.S.T.Q. | 1 | 4150-2406 |
| 1 | 300 | Penna. | OA Askarel | 3 | 12,470Y/7200-240 |
| 3 | 200 | Amer. | C.C. | 1 | 4160/7200-240/480 |
| 3 | 200 | G.E. | HS-W28 | 1 | 2400/4160-240/480 |
| 3 | 75 | G.E. | H-form KF | 1 | 2400/4160Y-120/240 |
| 1 | 75 | West. | DS Dry | 3 | 480/240-240/120 |
| 3 | 50 | Niagara | Dry-air | 1 | 2400/4160Y-120/240 |
| 3 | 50 | Harrison | Dry-air | 1 | 2400/4160Y-220/440 |

### MOTOR GEN. SETS

| QU. | KW | MAKE | SPEED | D.C. | A.C. |
|---|---|---|---|---|---|
| 1 | 1000 | West. | 720 | 600 | 2300/4160 S.R. |
| 1 | 400 | West. | 900 | 250 | 3 unit 4160 V. syn. |
| 1 | 300 | G.E. | 1200 | 250 | 2300/4160 syn. |
| 1 | 300 | Al. Ch. | 1200 | 125/250 | 3 unit 440 syn. |
| 1 | 175 | West. | 1200 | 125 | 4160 syn. |
| 1 | 100 | West. | 900 | 230 | 4160 syn. |
| 1 | 45 | G.E. | 1170 | 30 | 440V Sq. Cage |
| 1 | 300 | West SK | 900 | 250 | syn. 480 volts |

### D.C. MOTORS—230 VOLT

| QU. | HP | MAKE | SPEED | TYPE |
|---|---|---|---|---|
| 1 | 350 | G.E. | 1200 | ped. type |
| 1 | 90 | G.E. | 1750 | CDM |
| 1 | 30 | West. | 1750 | SK-113 |
| 1 | 30 | G.E. | 2200 | CD-85 |
| 1 | 15 | Crocker Wh. | 1750 | CCM, TEFC |

### SLIP RING MOTORS

| QU. | HP | MAKE | SPEED | TYPE | VOLTS |
|---|---|---|---|---|---|
| 1 | 500 | G.E. | 450 | MT-422Y | 2200 |
| 1 | 450 | West. | 1800 | CW 4-30-9 | 220 |
| 1 | 350 | West. | 1800 | CW | 2300 |
| 1 | 200 | West. | 385 | CW | 440 |
| 3 | 150 | Al. Ch. | 1760 | AY-RW | 2300 |
| 2 | 150 | G.E. | 590 | 1-16 | 4000 |
| 1 | 100 | West. | 1770 | TEFC B.B. | 220/440 |
| 1 | 75 | West. | 1160 | CW 607 | 220/440 |
| 1 | 75 | West. | 600 | CW 774C | 220 |
| 1 | 50 | G.E. | 570 | MT 552 | 220/440 |

### SQUIRREL CAGE MOTORS—3 phase—60 cyc.

| QU. | HP | MAKE | SPEED | TYPE | VOLTS |
|---|---|---|---|---|---|
| 1 | 300 | Al. Ch. | 1200 | TRW | 2200 |
| 1 | 300 | G.E. | 1800 | 63368 B.B. Drip | 4160/2400 |
| 1 | 275 | G.E. | 1180 | KT 559IS | 2200 |
| 1 | 75 | G.E. | 1790 | KTEFC B.B. | 2200 |
| 1 | 75 | Cont. | 1780 | K 6323-S XP B.B. | 440 |
| 2 | 100 | Cont. | 3570 | NP 585-S XP B.B. | 440 |
| 2 | 250 | G.E. | 3565 | NP5058X XP B.B. | 440 |
| 2 | 150 | G.E. | 875 | KT 552Y | 440 |
| 1 | 50 | G.E. | 3530 | KF 405Y Vert. | 220/440 |
| 1 | 50 | Cont. | 3530 | NP 445X XP B.B. | 220/440 |

### MOTORS—SYNCHRONOUS 3 ph, 60 cyc.

| HP | SPEED | MAKE | TYPE | VOLTS |
|---|---|---|---|---|
| 325 | 900 | West. | | 2300 |
| 400 | 450 | West. | HR | 440 |
| 300 | 720 | El. Mh. TEFC | | 2300 |
| 200/100 | 720/360 | West. | | 4150 |
| 150 | 3600 | G.E. | TS 956Y drip | 2300 |
| 150 | 1800 | G.E. | TS | 220/440 |
| 150 | 900 | West. | | 220/440 |
| 125 | 900 | G.E. | TS 7536 | 2200 |
| 125 | 600 | G.E. | TS 7641 | 2200 |
| 75 | 1200 | Cr. Wh. | ALT B.B. | 220/440 |

"FOR POWER"

## J.L. HEMPHILL & CO.

1603 34th STREET, NORTH BERGEN, N. J.

PHONE NEW YORK LONGACRE 5-1227

PHONE NEW JERSEY UNION 3-2600

Circle 14S on Reader Service Card

# 4 UNUSED CONDENSING 1250 KW WESTINGHOUSE TURBO GENERATORS

TURBINE: 540 lbs. and 850°T.T. working pressure. 8050 R.P.M.

GENERATOR: 1250 KW 440/3/60—0.80 power factor. 1200 R.P.M. with direct connected exciter. Steam rate about 12 pounds per KW hour.

UNITS SUITABLE TO PRODUCE 1500 KW WITHOUT ALTERATION.

### ALSO AVAILABLE:

We also have available the following equipment for the above units: 3200 sq. ft. condensers—3200 G.P.M. auxiliary circulating pumps and the condensate pumps.

*Send us your inquiries*

## THE BOSTON METALS CO.

313 E. Baltimore St., Baltimore 2, Md.

ELGIN 5-5050 LEXINGTON 9-1900

Circle 16S on Reader Service Card

### STOKER REPLACEMENT PARTS

For

WESTINGHOUSE-TAYLOR

And

Many Others — Satisfaction Guaranteed

MONUMENTAL STOKER SERVICE, INC.
OLD MONTGOMERY ROAD, ROUTE 1
ELLICOTT CITY, MD.

Circle 17S on Reader Service Card

# QUALITY EQUIPMENT and *outstanding* VALUES!

## LIKE NEW . . . RECTIFIERS AT 75% OFF COST

FOUR 1100 KW ALLIS-CHALMERS MERCURY ARC RECTIFIERS total 4400 KW, 16000 AMP, 3/60/33000/4160/2300 to 275-86 Volts complete with Automatic Controls • 4—1320 KVA OISC Transformers 3/60/4160-277 Volts with Inter-Phase Reactors • 2—4475/6925 KVA OA/FA REGULATING TRANSFORMERS 3/60/33000—4160 with 2300 tertiary winding and remote controlled tap changers.

Above Complete on Foundations — Can Be Purchased Individually

Complete Specifications & Blueprints Available

## BLOWERS & COMPRESSORS

24750 CFM Ingersoll-Rand Centrifugal Blower Type MTA465 4 Stage 27 PSIG Discharge Pressure 5100 RPM driven by Worthington 2600 HP Steam Turbine 125 PSI at 450°F.

19000 CFM Ingersoll-Rand Centrifugal Blower 2.25 PSIG Discharge Pressure—3600 RPM driven by 250 HP Westinghouse 3/60/2300 Volt TEFC Explosion-Proof Motor.

9920 CFM Clark Centrifugal Compressor Suction 149.4 PSIA, Discharge 239.4 PSIA at 6660 RPM Turbine driven by 4647 HP G.E. Condensing Turbine 190 PSI inlet steam with Intercooler & Control Board.

7500 CFM Allis-Chalmers V505 Centrifugal Compressor 42.5 PSIG at 8025 RPM Falk Speed Increaser and 1250 HP Synchronous Motor 3/60/2300V/1200RPM 1.PF 5KW direct connected Exciter, Precooler, Intercooler and Aftercooler with Synchronous Motor Starter.

4840 CFM Carrier Centrifugal Compressors 8100 RPM Suction Pressure 149.7 PSIA, Discharge Pressure 239.7 PSIA driven by 2066 HP Terry Turbine, Condensing, 430 PSI at 560°. (2 units)

3000 CFM Ingersoll-Rand PRE2 Compressor 125 PSI Discharge 33" & 20½" x 24" driven by 700 HP 3/60/2300 V. Synchronous Motor.

1360 CFM Worthington YO Compressor 35 PSI Discharge 15⅜ & 15⅜ x 7 direct connected to 150 HP 3/60/2200/590 RPM Louis Allis Explosion-Proof Motor.

604 Ton Carrier Freon 11 Refrigeration Compressor with Condenser and Cooler driven by 639 HP Terry Turbine 430 PSI Condensing.

## TRANSFORMERS

### UNIT SUBSTATION — NEW 1956

2174 KVA General Electric Type OA (2500 KVA with forced air), 33,000 Volt Primary, 2400 Volt Secondary, 3 phase, 60 cycle, 1200 Amp, 2.4 KV, 50 MVA Drawout Circuit Breaker with Relays, Ammeters, Voltmeter, Control Switch, etc.

### SINGLE PHASE — 60 CYCLE — OISC

| | |
|---|---|
| 2000 KVA West. | 13800 Volt Primary 2300 Volt Secondary (4) |
| 1000 KVA G.E. | 13800 Volt Primary 460 Volt Secondary (3) |
| 500 KVA Wagner | 66000 Volt Primary 460 Volt Secondary (3) |
| 500 KVA West. | 2300 Volt Primary 440 Volt Secondary (3) |
| 200 KVA West. | 2300/4160 Y Primary 440 Volt Secondary (3) |
| 150 KVA G.E. | 2400/4800/8320 Y Pri. 240/480 Volt Sec. (3) |
| 75 KVA Wagner | 4600 Volt Primary 115/230 Volt Secondary (3 |

### THREE PHASE — 60 CYCLE

| | |
|---|---|
| 3750 KVA G.E. | 33000 Volt Primary 2400 Volt Secondary NEW 1956 |
| 2000 KVA Al.Ch. | 33000 Volt Primary 2300 Volt Secondary NEW 1956 (2) |
| 1250 KVA G.E. | 2400/4160 Y Primary 240/480 Volt Secondary |
| 750 KVA G.E. | 4160 Volt Primary 480 Volt Secondary |
| 450 KVA West. | 13800 Volt Primary 460 Volt Secondary (6) |
| 150 KVA West. | 2400 Volt Primary 240/120 Volt Secondary 25 Cycle Hypersil |
| 112.5 KVA G.E. | 2400 Delta Primary 240/480 Volt Secondary-Dry Type |

### FURNACE — 60 CYCLE — SINGLE PHASE

| | |
|---|---|
| 2500 KVA G.E. | 13200 Volt Primary 95 to 155 Volt Secondary (6) |
| 2500 KVA West. | 11500 Volt Primary 95 to 125 Volt Secondary (3) |
| 2000 KVA West. | 13200 Volt Primary 120 Volt Secondary NEW (3) |
| 5000 KVA West. | 2300 Volt Primary 100 to 249 Volt Secondary—Three Phase |

### FURNACE —25 CYCLE — SINGLE PHASE

| | |
|---|---|
| 4450 KVA G.E. | 11000 Volt Primary 80 to 140 Volt Secondary (3) |
| 2500 KVA West. | 10000 Volt Primary 70 to 140 Volt Secondary |
| 750 KVA G.E. | 12000 Volt Primary 45 to 60 Volt Secondary |

## GENERATORS

(2) 750 KW General Electric Motor Generator Sets Synchronous Motor Drive 1100 KVA 900 RPM Type TS 3 Phase, 60 Cycle, 2200 Volt Direct Coupled to 750 KW Type MPC8 Generators 3000 Amp 250 Volt with enclosed AC and DC Controls.

(1) 500 KW General Electric Non-Condensing Turbo Generator 265 PSI Initial Pressure 10#BP 3/60/480 Volt 3600 RPM.

(2) 1250 KVA General Electric Condensing Turbo Generator 200 PSI 1000 KW 3/60/2300 Volt 3600 RPM.

## CIRCUIT BREAKER CUBICLES NEW 1956

Complete with Meters & Relays

1200 Amp Westinghouse Type 345CA
1500 MVA 34.5 KV Drawout Breakers (8)
2000 Amp Allis-Chalmers Type AM150C
150 MVA 4.16 KV Ruptair Drawout Breakers (2)
1600 Amp Allis-Chalmers Type G50A
50 MVA 600 Volt Drawout Breakers (4)
600 Amp Allis-Chalmers Type G25
25 MVA 600 Volt Drawout Breakers (9)

## D.C. CIRCUIT BREAKERS

(3) 2000 Amp 125 Volt Single Pole Air Circuit Breakers manual closing, on Panelboards.

## AUTO TRANSFORMER

1950 KVA Oil Insulated 3/60/2300 V

## MOTORS

### 230 VOLT DC MOTORS

| HP | MAKE | TYPE | SPEED | WINDING |
|---|---|---|---|---|
| 150/200 | G.E. | MDS418AE2 | 730 | Series |
| 75 | G.E. | MD414AE | 475 | Series |
| 75 | CR.WH. | CCM | 850/1060 | Comp. |
| 45 | G.E. | MD410AE | 550 | Comp. |
| 35/45 | G.E. | MD410AE | 525 | Series |
| 33 | G.E. | MD408AE | 625 | Comp. |
| 15/19 | G.E. | MD406AE | 650 | Series |
| 6/10 | G.E. | CD85 | 850 | Shunt |
| 5 | G.E. | MD403AE | 700 | Comp. |

### CLASS I GROUP D — 3 PHASE 60 CYCLE

| HP | VOLT | RPM | |
|---|---|---|---|
| 350 | 2300 | 3600 | |
| 250 | 2300 | 3600 | (3) 1 NEW |
| 250 | 2300 | 710 | |
| 200 | 2300 | 3600 | |
| 150 | 2300 | 3600 | |
| 125 | 2300 | 1800 | |
| 100 | 2200 | 3600 | |

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# Heat and Power Co., inc.

60 E. 42nd STREET, NEW YORK 17, N. Y. MU 7-5280

310 THOMPSON BLDG., TULSA 3, OKLA. LU 3-4890

**DIESEL GENERATOR SETS—3 ph., 60 cy.**

| QTY | KVA | MAKE | VOLTS | RPM | YEAR |
|---|---|---|---|---|---|
| 2 | 1000 | Hamilton | 2300 | 600 | 1945 |
| 3 | 1250 | G.M. | 2300 | 720 | 1945 |
| 2 | 350 | G.M. | 220/440 | 1200 | Rebuilt '60 |
| 1 | 375 | G.M. | 220/440 | 1200 | 1945 |
| 1 | 412 | Worth. | 240 | 600 | 1949 |
| 1 | 150 | Superior | 240 | 1200 | 98% New |
| 1 | 150 | F.M. | 2300 | 300 | 1940 |
| 1 | 37.5 | Buda | 240 | 1200 | 98% New |
| 1 | 31.5 | Cummins | 240 | 1200 | 98% New |

**STEAM TURBO GENERATORS—Non-Cond.**

| KW | MAKE | VOLTS | STEAM | EXHAUST | YEAR |
|---|---|---|---|---|---|
| 5000 | G.E. | 2400/4160 | 825# | 265/20 | 1954 |
| 3000 | G.E. | 2300 | 200# | 15 | 1923 |
| 3500 | G.E. | 2300 | 250# | 20 | 1955 |
| 1000 | G.E. | 2300 | 400# | 90/125 | 1945 |
| 1000 | Elliott | 480 | 325# | 145/20 | 1950 |
| 750 | G.E. | 480/4800 | 165# | 15 | Late |
| 300 | Allis | 2300 | 175# | 3/20 | Late |
| 250 | Allis | 240 | 140# | 6/20 | 1948 |
| 125 | Allis | 240 | 140# | 6/20 | 1948 |

**STEAM TURBO GENERATORS—Condensing EXTR.**

| KW | MAKE | VOLTS | STEAM | LB. | YEAR |
|---|---|---|---|---|---|
| 5000 | G.E. | 2400/4160 | 825# | 265 | 1954 |
| 3000 | G.E. | 2300/4000 | 250# | 15 | 1937 |
| 350 | G.E. | 4800 | 825# | 265 | 1954 |
| 3000(2) | G.E. | 2300/4160 | 400# | — | 1940 |
| 1000(2) | Elliott | 480 | 155# | — | 1948 |
| 750 | West. | 480 | 175# | 15 | 1940 |
| 600(2) | G.E. | 600 | 150# | 10 | 1930 |
| 400(2) | Elliott | 480 | 175# | — | 1956 |
| 200 | Worth. | 480 | 200# | 50 | 1947 |

**PACKAGE BOILERS**

| Q | HP | MAKE | W.P. | FIRING | YEAR |
|---|---|---|---|---|---|
| 4 | 500 | Cl. Bk. | 200 | Oil | 1942 |
| 1 | 200 | Erie | 160 | #6 | 1951 |
| 1 | 150 | Cyclotherm | 150 | #6 | 1947 |
| 1 | 150 | Cl. Bk | 15 | #6 | 1936 |
| 1 | 70 | Ames | 15 | #2 | 1951 |

**AIR COMPRESSORS**

| CFM | PSI | MAKE | TYPE | H.P. | VOLTAGE | RPM | YEAR |
|---|---|---|---|---|---|---|---|
| 7550(2) | 24/30 | I.R. | XHE | 600 | 3/60/4160 | 300 | 1948 |
| 4000 | 125 | I.R. | PRE | 700 | 3/60/2400 | 164 | 1946 |
| 1853 | 125 | Worth. | DC-2 | 300 | 3/60/2300 | 277 | 1946 |
| 2000(2) | 100 | Fuller | Rot. | 300 | 3/60/2300 | 600 | 1942 |
| 676(2) | 125 | C.P. | OCE | 125 | 3/60/480 | 277 | — |
| 515(4) | 125 | I.R. | 40 | 100 | 3/60/440 | 870 | 1940/50 |
| 494 | 125 | I.R. | XRB | 75 | 3/60 | 277 | — |
| 464 | 100 | I.R. | ES-1 | 75 | 3/60 | 300 | 1950 |
| 368 | 100 | I.R. | ER-1 | 60 | 3/60 | 277 | Late |

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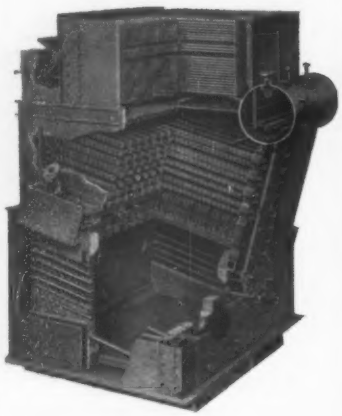
## MAIN BOILER UNITS

**built by North Carolina Shipbuilding Co.**



**DESIGN DATA:**

**Pressures**, lb. per sq. in. (normal power)
- Steam drum design ..... 500
- Steam drum operating ..... 459
- Superheater outlet operating ..... 450

**Temperatures**, deg. F. (normal power)
- Superheated steam ..... 750
- Feedwater ..... 318
- Air heater gas outlet ..... 340
- Air to burners ..... 350

**Evaporation Rate**, lb. per hr. actual
- (normal power) ..... 26,500
- (overload) ..... 39,750

**Draft Loss**, in. w.g. (normal power), 15 per cent excess air, air inlet to gas outlet ..... 2.3

**Furnace Volume**, cu. ft. ..... 405

**Heating Surfaces**, sq. ft.
- Boiler and water walls ..... 4,060
- Superheater ..... 640
- Air heater ..... 3,375

**Weight**, lb.
- Weight of one complete unit, dry 108,737

**THE BOSTON METALS CO**
313 E. Baltimore St., Baltimore 2, Md.
ELGIN 5-5050 — LEXINGTON 9-1900

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## INDUSTRIA AZUCARERA

**DOS TURBINAS "DE LAVAL" C/REDUCTOR "BUILT-IN" PRACTICAMENTE NUEVAS PARA ACCIONAR MOLINOS DE CAÑA—**

- PRESION ENTRADA—125-175 PSIG—SALIDA 12 PSIG
- RECALENTAMIENTO—100°F
- CONSUMO ESPEC. 50#/KWH A 125#/SIG-100°F.—12#/SIG
- RPM TURBINA—4130
- RPM SALIDA REDUCTOR—514
- POTENCIA—2175 HP
- POTENCIA REGULABLE MEDIANTE 5 VALVULAS DE ADMISION PARCIAL DE VAPOR ENTRE 500Y 2175 HP A 4130 RPM

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## COMPRESSORS

**No better values at any price**

72 CFM 1500 PSI 6¼-3¾-1⅝x7 CP
80 CFM 3500 PSI 6¾-4-1 7'16x9 IR ES3
138 CFM 100 PSI 7x7, Ing. ES. CP & Joy
208 CFM 350 PSI 9-4x9 Ing. ES2
258 CFM 500 PSI 9½x4¼x11 Ing. ES2 New
288 CFM 100 PSI 9x9 Ing. Worth. CP
311 CFM 1500 PSI 10½x7⅞-3½-13 IR-ES3
465 CFM 100 PSI 12x11-IR-ES CP.T. Worth HB
502 CFM 125 PSI 12x13 Worth HB
676 CFM 110 PSI 15-9¾x12 Ing. XRE
686 CFM 100 PSI 14x13 Ing. ES
860 CFM 125 PSI 13-8x7 Joy WN102
1352 CFM 125 PSI 18½-11½x8 Ing. XLE 200 HP Syn 3-60-4160
2200 CFM 100 PSI 26-15x28 Ch. Pn. wee 350-HP 3-6-4160-4600 .8 PF
1750 CFM 125 PSI 15½-10x10 Ch. Pn. wee 300 HP Syn. 3-60-2300

**American Air Compressor Corp.**
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POWER EQUIPMENT CO.
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Chicago 45, Ill.

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# BOILERS

**From the unfinished Battle Cruiser "Hawaii"**

Material installed completely and never used.

**7 Babcock & Wilcox Watertube Boilers**

Approximately 157,000 lbs/hour. Working pressure 600#—850° T.T.—Oil-fired—with all boiler trim. Units are complete with fuel oil burning equipment—feed water pumps—feed water heaters, etc. Units are in prime condition.

**CAN BE LOADED AS A UNIT OR DISMANTLED AND SHIPPED IN SMALLER SECTIONS**

**THE BOSTON METALS CO.**
**313 E. Baltimore St., Baltimore 2, Md.**
**ELGIN 5-5050 — LEXINGTON 9-1900**

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5—435 Hp Comb. Eng. water-tube boilers, 300 psi, gas or oil.
1—G.E. 1500 KVA unit substation, 13200—480 V.
3—Worthington 3500 CFM air compressors, 24x15, #LTC-4, 500 HP gas drive.
1—Chicago-Pneu. 3060 CFM air comp., #19-32-30-18x24, 60 PSI, steam drive.
3—G.E. 1000 KVA transformers, 1Ø, 13800-V.
2—200 HP water-tube boilers, 160 PSI.
1—Gardner-Denver air comp., 445 CPM

**PERRY EQUIP. CORP.**
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Philadelphia 22, Pa.
POplar 3-3505

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# 75 TON BRIDGE CRANE

1—75 Ton capacity Whiting Mfg. Co. bridge crane with auxiliary hoist, 51 ft. span, complete with operating motors, control and rail.

*Excellent condition.*

*Can be inspected in operation.*

**UTILITIES MACHINERY CORP.**
1965 EAST SIXTH STREET
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# SKINNER VERTICAL UNIFLOW

250 KVA, 480 volt, 3 phase, 60 cycle Skinner, 2 cylinder vertical used universal uniflow generating unit, steam pressure 150 to 175 pounds throttle pressure, 2 to 5 pounds back pressure.

*Available for Immediate Shipment*
*From Original Foundations in Illinois.*

FRANK M. BEESON ENGINEERING CO.
1511 W. 27th St., Los Angeles 7, Calif.
RE 5-9820

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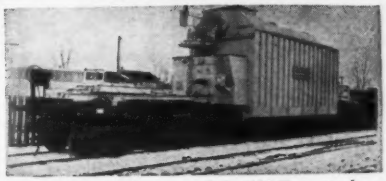
# NEW—UNUSED—ASSEMBLED

**88,000 LBS/HR**
**235 PSI.**



Union Iron Works package type water tube boiler, model MH-T, rated at 88,000 lbs/hr.—235 psig assembled, and delivered new in 1960—never placed in operation—steel encased and capable of being shipped intact aboard RR car without dismantling. IMMEDIATE DELIVERY. Fully equipped.

## OTHER BOILERS IN STOCK

50 hp. Mund Scotch Marine package, oil, 125 psi, fully automatic, new, unused (7)
100 hp. Cycloth. package 125 psi., oil, automatic
150 hp. Cleaver Brooks package, 150 psi,, oil, automatic
175 hp. Comb. Engr. package 375 psi., oil, automatic
200 hp. Cleaver Brooks, package, 125 psi, #601L, automatic, complete, (2)
500 hp. Cleaver Brooks, package, 150 psi., oil automatic
300-600 hp. Bigelow Scotch Marine Boilers, 3,000 sq.ft., 200 psi, complete package units, automatic, etc. (1955) (3)
10,000 lbs/hr., B&W, package watertube, 2100 psi, oil, compl. (exc. for testing purposes)
45,000 lbs. B&W, 435 psi., packaged, oil, assembled, unsued, ready to ship
45,000 lbs. C-Engr. 250 psi. 2 drum assembled, ready to ship
60,000 lbs. B&W, 475 psi., oil, packaged, assembled unused, ready to ship
100,000 lbs./hr.—Riley, 200 psi, comb. oil-gas firing, Ron design
195,000 lbs, C Engr., 950 psi., 2 drum, stoker and oil, superheat, etc. Completely installed new 1954. All 2½" Tubes.

***complete listing catalogue sent upon request***

**HI PRESSURE BOILERS 10-5000 H.P.**
USED—NEW—PURCHASED—SOLD—RENTED
Large and Complete Inventory for Domestic and Export

**INDECK POWER EQUIPMENT CO.**
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# TRANSFORMERS

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**MANUFACTURED**

*Ask for our Stock List*

For Sale
3—2500 KVA G-E 69000—2400/4160Y
3—2500 KVA G-E 69000—7200/12470Y
3—1500 KVA G-E 6900—2400/4160Y
3—1500 KVA G-E 69000—7200/12470Y
3—1000 KVA G-E 34500—7200/12470Y
3— 833 KVA W-H 43800—480
3— 667 KVA G-E 13200—2400/4160Y
3— 500 KVA A-Ch. 2400/4160Y—240x480
3— 500 KVA A-Ch. 7200/12470Y—240x480

**THE ELECTRIC SERVICE CO., 5322 Hetzel St., Cincinnati 27, Ohio**
*"America's Exclusive Independent Transformer Service Shop"*

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## *FOR SALE*

1—2000 KW G.E. Turbine-Generator 400#-750° F Throttle, Automatic 150# and 85# Extraction, 10# Exhaust. Generator is 2500 KVA, 3-60-480 Volt, with exciter and accessories.

1—135 HP Titusville Boiler 15# W. P. 4485 Lbs. per hour, 1072 square feet of heating surface 212° feed water. Oil Burner and Controls, Excellent condition $2000.00

## WANTED

2500-5000 KW Turbine-Generators 400-600# Throttle, condensing or non-condensing.

***Write to:* JOLIET EQUIPMENT CORPORATION**
**Box 1078, Gross Street, Joliet, Illinois**
**or Phone: Joliet SA 7-4738 Chicago BI 2-2458**

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**10—SUPLUS DUAL FUEL CYLINDER HEADS**

Nordberg, 21½" bore, dual fuel engine. Also other surplus Diesel parts and equipment. Advise needs.

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**645 N. Michigan Ave., Chicago 11, Ill.**

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**TRANSFORMERS**
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WORLD'S LARGEST INVENTORY
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P.O. BOX 51 · ROCHESTER 1, N. Y.

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The LimiTorque Motorized Valve Operators shown above are mounted on 10" Chapman Gate Valves, operating on boiler feed water line at 3600 p.s.i. . . . one of which is equipped with D.C. motors for emergency operation. Many LimiTorque Operators are used in this modern plant for the operation of valves on various steam and water lines . . . thousands of LimiTorque Operators are in constant use in Power Plants throughout the World.

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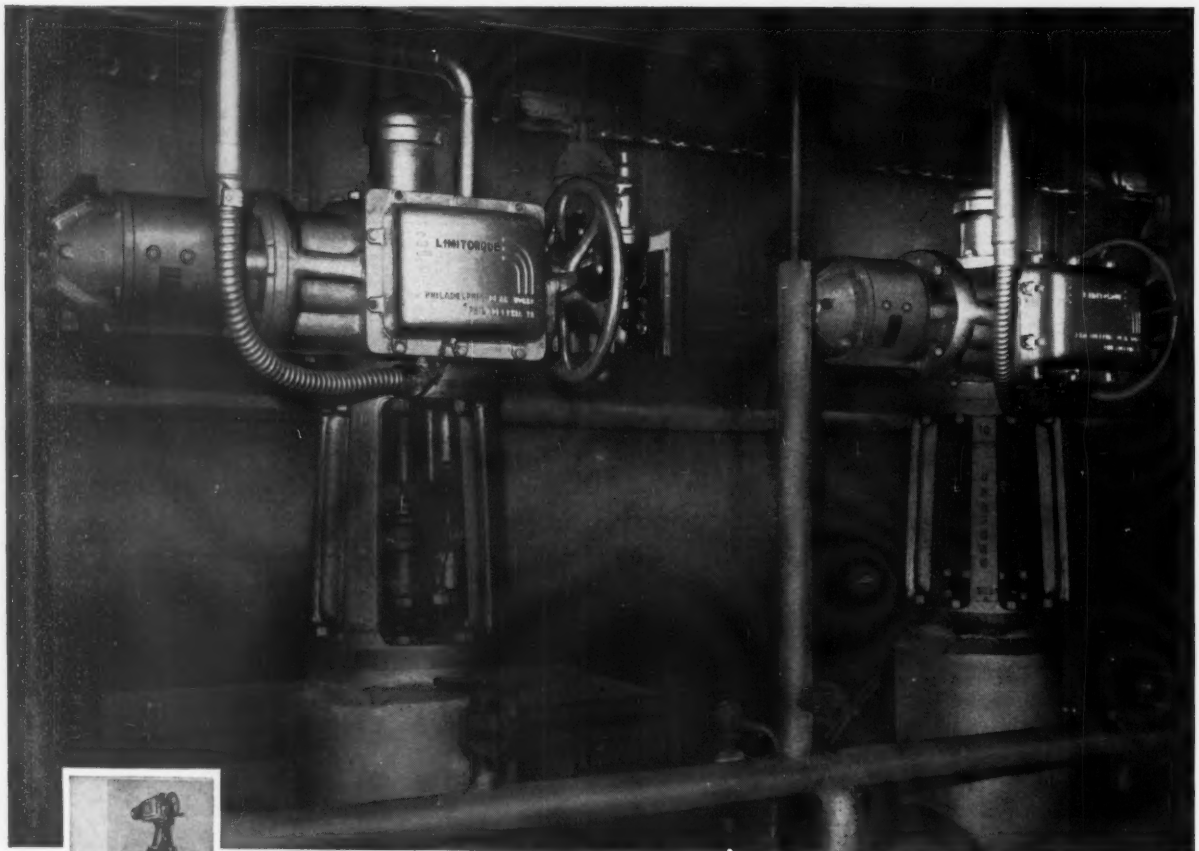
For further information contact your valve manufacturer or your nearest LimiTorque Sales-Engineering Office.



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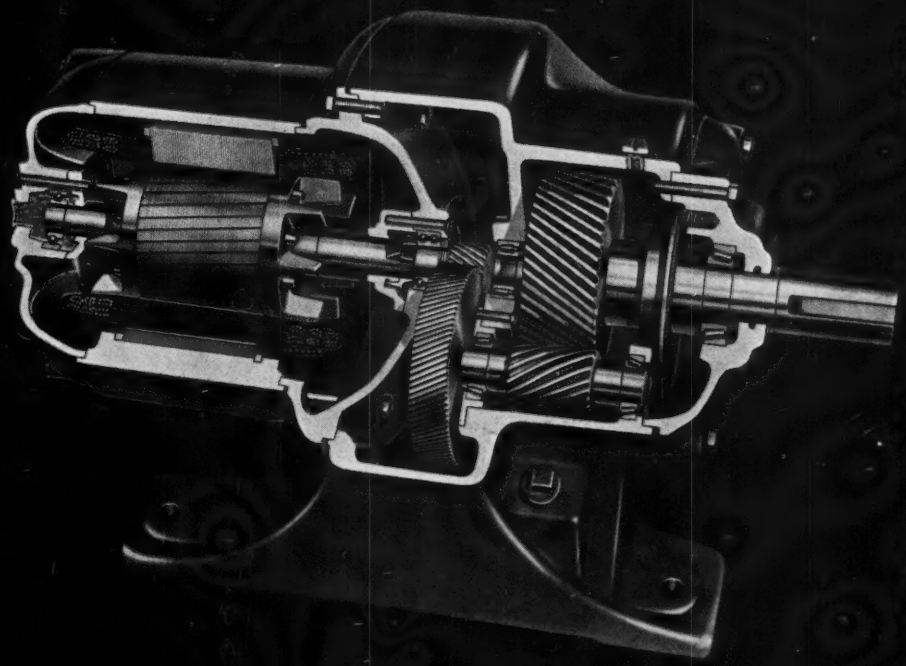
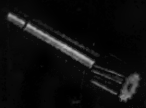
Only U.S. SYNCROGEAR has all these features...

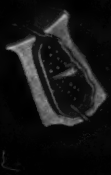


**RUGGED PYRAMIDAL CASE** prevents distortion or misalignment.

**SOLID SHANK BUILT-IN PINION** can't vibrate or work loose.

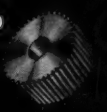


**ASBESTOS PROTECTED WINDINGS** will not deteriorate from heat.



**ONE-PIECE SUPPORTING CASE** assures permanent alignment of gears, pinions.

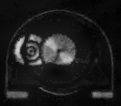
**THROUGH-HARDENED GEAR TEETH** give greatest strength, longest wear.



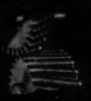
**NORMALIZED CASTINGS** prevent warping, misalignment of gears, shafts.

**FRICTION-FREE OIL SEAL** can't wear, prevents leakage.

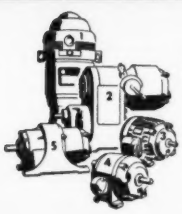
**POSITIVE AUTO-LUBRICATION** by slow-gear dip prevents churning



**MICRO-SHAVED AND HONED GEAR TEETH** provide smooth operation, long life.



U.S. SYNCROGEAR MOTORS offer the *most features* to provide long life and dependability. For a quarter-century, U.S. Syncrogears have led design progress. (Available 1/3 to 75 h.p.—single-, double-, triple-reductions, and worm-geared.)



**U.S. MAJOR MOTOR LINES INCLUDE:**
1. Vertical Solid & Holloshaft, 2. Varidrive, 3. Totally-Enclosed, 4. Uniclosed, 5. Syncrogear. Also, many other special motors.

**FREE SYNCROGEAR BROCHURE No. F-1880**
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P.O. Box 2058 • Los Angeles 54, California or Milford, Conn.

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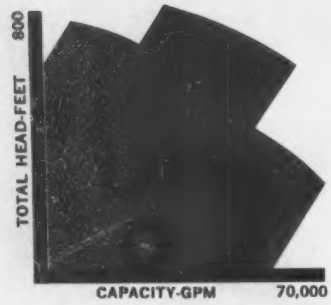
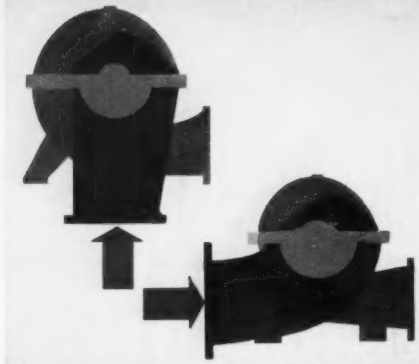
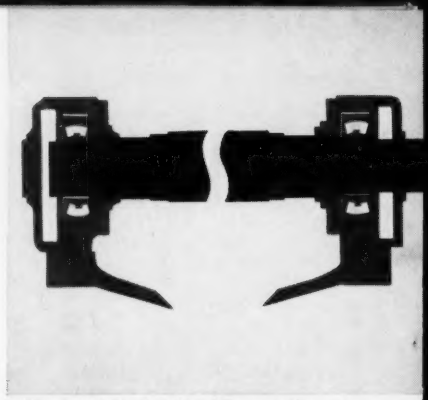


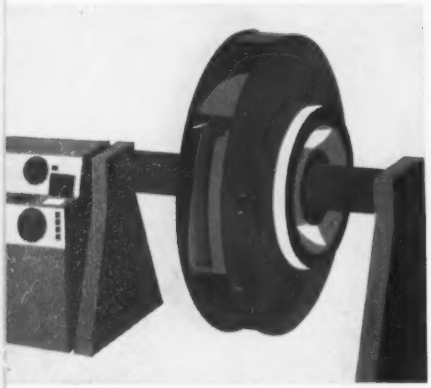

PERFORMANCE. Broad coverage gives precise selection for highest efficiency.



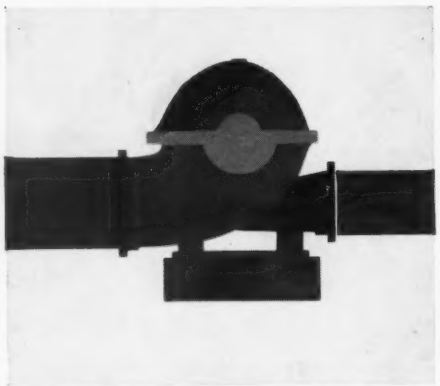
PERFORMANCE. Best because side or bottom suction matches installation best.



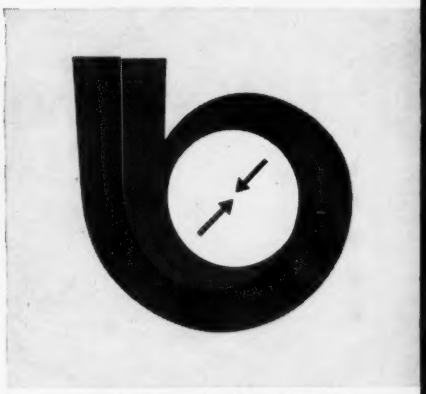
LIFE. Longest—bearing life actually exceeds any known specification requirement.



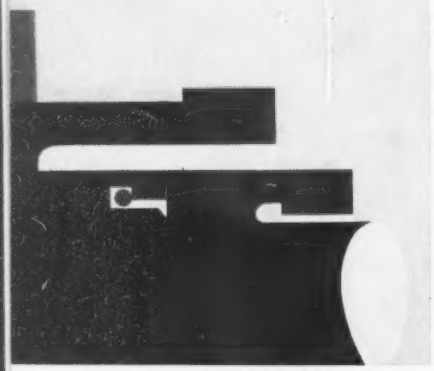
LIFE. Longest—impellers are dynamically balanced to cut bearing and packing wear.



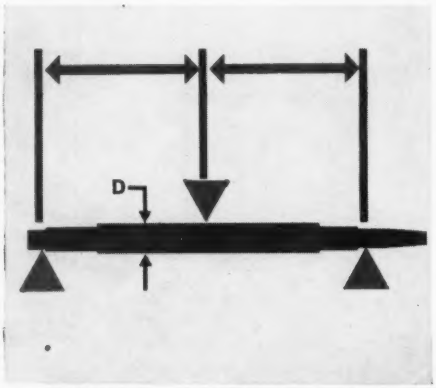
MOST ECONOMICAL. Space and piping required smaller than comparable pumps.



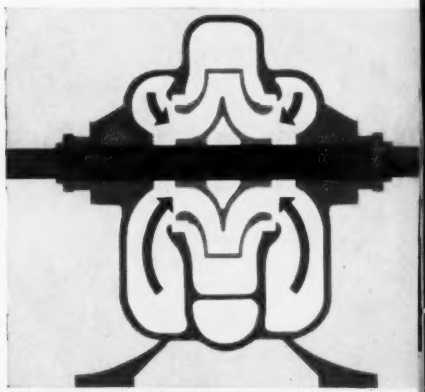
LIFE. Longest because double volute designs are used for better radial balance.



LIFE. Longest—exclusive "O" ring arrangement gives best erosion protection.




LIFE. Longest—shaft diameters and bearing spacing provide minimum deflections.



PERFORMANCE. Efficiency sustained best because of truly functional design.

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LN pumps have been engineered to take full advantage of double volute construction. It's the most complete line of double volute pumps made. The double volute, of course, extends operating range from design point to shut-off without harmful effects from excessive deflection. Similarly, pump life is longer because the bearing brackets are cast and machined with the casing to give perfect alignment.

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Most important, however, we believe that no other pump on the market can equal the low cost of installing, operating and maintaining LN pumps. Frankly, we'd like to quote the LN line for you, so you see its total value in a competitive light.

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